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Archives of Neurology and Psychiatry

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THE PROGNOSIS OF INVOLUTION MELANCHOLIA *

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"Involution melancholia," sometimes spoken of simply as "melancholia," is one of the most frequent forms of mental disease, and the term is one of the oldest in psychiatry. Nevertheless, the clinical position of this group and the outcome of the psychosis are still matters of dispute. Until 1907 the disease was generally held to be a clinical entity with variable prognosis. For instance, in the seventh edition of his textbook, Kraepelin says: "It includes all pathological states of anxiety in more advanced age, which are not episodes in the course of other forms of insanity. Delusions belong also to this clinical picture in addition to the mood disturbances." As to the prognosis, he found that 32 per cent. of his cases were chronic, while 19 per cent. of his patients died within two years after the onset.

Only one important objection was made to the view that involution melancholia is a disease by itself. Thalbitzer [1] asserted that melancholia was related to the "angry mania" of Kraepelin and that the latter's third "mixed condition of manic-depressive insanity," the "depressive excitement," was practically identical with melancholia. These views, however, were not widely accepted.

In 1907 appeared a work by Dreyfus [2] which was rather revolutionary in its effects. He investigated the later development of eighty-

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* This is a problem which interested the late Dr. Hoch for many years. In the spring of 1919 he began a review of 108 cases which he had examined between the years of 1895 and 1905 at the McLean Hospital in Waverly, Mass. Through the courtesy of Dr. Packard of the McLean Hospital and the superintendents of a number of other hospitals to which some of these patients had been transferred, it was possible to learn the outcome of the majority of the psychoses observed. Together we began an analysis of this material and reached some tentative conclusions. Since the untimely death of the originator of this work, a reexamination of the case histories seems to confirm these first formulations and justify a published report.—J. T. M.

[1] Thalbitzer, S.: Melancholie u. Depression, Allg. Ztschr. f. Psychiat. **62:** 1905.

[2] Die Melancholie, Jena, 1907.

five cases in which the diagnosis of melancholia had been made in the Heidelberg Clinic since 1892. He found that a large number of patients whose condition had been considered irrecoverable, even deteriorated, finally recovered, although the favorable outcome might not appear for almost ten years. The conclusions he drew have had much influence on psychiatric classification, for many physicians have followed him in regarding these cases as belonging to the manic-depressive group. He argued that many patients give a history of prior attacks and some pass from melancholia into a manic phase. This would indicate that the behavior of the psychosis is the same as that of the recognized forms of manic-depressive insanity. Patients fail to recover only in rare instances when the melancholia passes over into arteriosclerotic dementia. The ultimate prognosis is therefore as good as in manic-depressive insanity except for the frequency of death in these advanced ages. Finally, the clinical picture is made up of manic-depressive symptoms, particularly those of the circular "mixed conditions." Specificially these are, of the manic group: emotional variations (sometimes in the direction of euphoria but often as cessation of the depressive mood in the latter part of the day); excitability and irritability; need of communicating troubles; pressure of speech; flight of ideas; inflation of the ego; even with expansive ideas. On the depressive side the symptoms in common with melancholia are obvious: painful emotions of sadness, anxiety, etc., and inhibition of thought.

Both his evidence and arguments have carried much weight with psychiatrists, particularly in Germany. Kraepelin, for instance, has accepted them, practically in toto, and in the eighth edition of his textbook has eliminated melancholia as a separate nosologic category. One effect of this has been to make Kraepelinian depression a complex and puzzling picture. In it all kinds of clinical entities are assembled and many varieties of emotion, the one constant feature being an unpleasant affect, whether this be of sadness, anxiety or a painful tension.

Argument, however, may be directed against Dreyfus' assertions. The most crucial question is that of prognosis. Since his work psychiatrists have been more on their guard against making pessimistic prognostications, yet they know that some patients do not recover. For instance, in our series there are patients whose psychoses persisted practically unchanged for as long as twenty years without the development of symptoms pointing to arteriosclerosis. Invariability of recovery is, therefore, not a feature of involution melancholia. A history of prior attacks certainly tends to make one expect the psychosis in question to be benign, but we get the impression on reading his case reports that Dreyfus' zeal outran his judgment. In a number of cases he ferreted out a history of depressions so mild as to seem to be neuroses or merely more or less normal mood swings. Variations of the emotional status are of great theoretic, psychologic importance, but they should not be called "psychoses" as long as their manifestations remain within certain limits. Otherwise nearly the whole world is, or has been, insane. As to his claims for the appearance of manic and other manic-depressive symptoms, we cannot find this convincing. There are, in psychiatry, few pathognomic symptoms. Clinical types are made up of certain groupings of symptoms. For instance, by selecting and putting together the proper features of a number of manic-depressive cases, one could easily paint a fair picture of dementia praecox. Yet no one would ally dementia praecox with manic-depressive insanity for that reason. Similarly, intensive study of a normal person may enable one to recognize in him all these symptoms. If sad, happy or worried, should he be called insane? Some of the symptoms he mentions are peculiarly nonspecific. For instance, emotional variations, excitability and irritability appear not only in normal reactions but in general paralysis, epilepsy, deliria, dementia praecox and manic-depressive anxiety. Other symptoms are extreme rarities in involution melancholia. Of these we may cite grandiose ideas (in pure form) and flight of ideas.

In spite of these objections, however, one feels that there is evidence for believing that some relationship with manic-depressive insanity exists. When a psychosis occurs that is one of a series in the same person, that is characterized by emotional disturbance and ends in recovery, it is hard to deny it kinship with manic-depressive insanity. On the other hand, if the chronic cases are to be included with the benign, this forces a modification of our ideas about manic-depressive insanity in an essential point. If the bar of good prognosis be let down, one would have to admit many cases of dementia praecox as well. An alternative is thinkable. It may be possible to differentiate between the benign and malignant melancholias, relating the former to manic-depressive insanity and the latter to dementia praecox. This could be done only if it were found that the prognostically bad symptoms were of a kind which we already view as schizophrenic in tendency. The results of our studies would seem to point in this direction.

Our program was to study the patients who recovered and thus determine what symptoms were benign. We then examined the histories of the patients who did not recover to discover the differences in their symptoms from those of the first group. Sufficient data were available in sixty-seven cases to justify their inclusion in this report. Of the others, it was either impossible to learn what the outcome of the psychosis was, or death ensued too early to justify any conclusion as to the chronicity of the disease. Among the patients who had recovered it was found that the average period before improvement was nine and one half months; thirty-three improved during the first year of the psychosis, five during the second, one during the third and three during the fourth. One patient improved markedly after two years, then relapsed and began to recover only eight years after onset. The last was considered so anomalous a case as to justify the rule that patients with curable melancholias begin to improve in less than four years. We, therefore, have included among the chronic cases those of all patients who died more than four years after the psychosis began without showing any signs of recovery. Justification for this was evident when it appeared that the patients who died unimproved after this lapse of time showed the symptomatology of the chronic type.

Regardless of whether these cases shall be grouped with manic-depressive insanity or not, we believe it leads to greater clarity of understanding to discriminate between the typical manic-depressive depressions of early and middle life and the psychoses characterized as involution melancholias. We would define the former as reactions consisting of feelings of sadness, hopelessness, wickedness, incapacity and unreality on the subjective side, with objective evidence of physical and mental sluggishness and an appearance of dejection in attitude and facial expression; such delusions as appear are concerned with the moral obliquity of the patient, while hallucinations are extremely rare. In the melancholias, on the other hand, on a general background of such symptoms, appear fearful delusions and marked anxiety, often with terrifying hallucinations; a strong tendency to hypochondria sometimes leading to fantastic delusions; gross anomalies of conduct with much irritability, perversity and sometimes filthiness; finally, some patients show a loss of adequate emotional response to their environment or to their own ideas. Between these two types there are innumerable transitions, but between their extremes a marked contrast exists. (In the same way transitions are seen between manic-depressive insanity and dementia praecox.) What we will term the manic-depressive depression appears in later periods of life just as in youth and middle age. When there is no complication these patients recover and present no greater problem at this than at other ages. Our task lies with the cases of melancholia proper.

In his seventh edition, Kraepelin outlines the prognostic data of involution melancholia as follows: In general, an unfavorable outcome is to be expected with a loss of emotional reaction unaccompanied by a recession of delusions or with the development of absurd ideas. In milder cases, the emotional disturbance gradually disappears in company with the delusions, although the patients, in spite of an uncertain insight, become duller, their will power is weakened and they become less active, often assuming an inferior or whining attitude. With greater deterioration delusions gradually fade away. The patients develop a poverty of ideas, their minds become unclear, and they become forgetful, indifferent and incapable of work. They have no insight but stand around dully, complaining monotonously. In some the definite picture of senile dementia develops. From this it will be seen that Kraepelin gives no criteria for predicting deterioration but rather describes what happens when deterioration takes place. We have attempted to study in retrospect the symptoms of the patients who recovered and of those who did not, in order to discover, if possible, what features in the earlier stages of the psychosis have a bad prognostic import.

SYMPTOMS OF INVOLUTION MELANCHOLIA

In order to present our material in concise form, the cases are arranged in tables showing the presence or absence of symptoms which we have come to regard as peculiar to involution melancholia and essential in the prognosis, while a supplementary table gives a synopsis of all or most of the symptoms presented by the same patients.

A brief description of these essential symptoms may make the tables clearer. The type of emotional reaction is briefly indicated so that no further explanation of this is needed. Different categories of delusions are given in the next three columns. The first category of death and poverty ideas is important because these fancies are highly typical of any kind of involution melancholia. Death is usually represented in a violent form—the patient is going to be hanged, electrocuted, cut up, burned, buried alive, and so on. The wild fear so characteristic of these cases apparently is often a response to these thoughts. Sometimes the fancies appear in disguise as a delusion of immortality. The patient cannot die, no matter how he may suffer from starvation, torture or injury. In other cases there may be an elaboration of the theme into thoughts of wholesale murder. All relatives, all friends, all nurses, patients and physicians have been killed or are going to be; dead bodies are piled around, and so on. Probably related psychologically to loss of life is the delusion of poverty. In its mildest forms this is merely a worry about expenses, in the most exaggerated types the patient is convinced that the family fortune is dissipated and his relatives are all in the poorhouse. None of the death or poverty delusions seems to have any bearing on the ultimate psychosis. Three quarters of all patients have them.

Hypochondria.—Even more frequent are the hypochondriac fancies. We have divided these into two groups which seem to have some fairly definite relationship with the outcome. In the first group, which we term "mild hypochondria," there are worries and complaints about health, pains, queer sensations, indigestion, constipation, etc., which are identical with, or analogous to, the complaints every physician is constantly hearing from his nonpsychotic but neurotic patients. In involution melancholia, such imaginations simply tend to be more stressed. In the second type similar ideas are exaggerated into senseless and ridiculous delusions which often are associated with anal practices or other auto-erotic practices or fantasies. For instance, the patient declares he cannot swallow, although he may just have eaten; that his organs are all gone; that his bowels never move, that he passes so much by rectum that all the sewers are plugged; that an odor from him defiles the world; that he is paralyzed (while making movements); that he is only a foot high, and so on with endless variations. Such patients are often filthy in their habits, pulling feces out of the anus with their fingers, smearing the furniture and themselves. Frequently they masturbate shamelessly, pull ceaselessly at their lips, etc. One practice which might be considered auto-erotic but which occurs often in convalescing patients is that of picking at the fingers, which may be more of an expression of restlessness than of indirect onanism.

Irritability.—Some discrimination between the conduct of patients recovering and that of patients with chronic cases of melancholia may also be made. Although a certain degree of irritability is frequent in the more serious benign psychoses, there is a tendency to constant peevishness only when the prognosis is grave. These patients seem to resent any attention with rude words; scratching, biting and striking, sometimes with surly expressions of a desire to be left alone. This conduct is extraordinarily like that of a spoiled child in a tantrum.

Inadequacy of Emotional Reaction.—Deserving separate listing is the inadequacy of emotional reaction which occurs frequently in deteriorating cases. The psychoses with good prognosis show, as a rule, strong, even violent, affective symptoms. It seems to suggest a bad outlook when a patient has thoughts of being killed and is indifferent. A more serious sign is a narrowing of the mental horizon when interests one by one disappear and attention is focused more and more on the patient's body or on his troubles. These patients wander around monotonously whining a stereotyped complaint. A small but rather definite subgroup is that group of patients who have what we have been accustomed to term organic insufficiency, since the whole picture seems to reflect a fundamental and general senescence rather than a localized cerebral abiotrophy with senile dementia or a largely psychogenic disturbance, such as characterizes so many of the involution melancholias. These cases usually begin with insomnia followed by a gradual loss of interest. If there are any self-accusations or paranoid or death ideas, they are in the background of the clinical picture. There are hypochondriac ideas, but these usually are concerned with the patient's condition in a vague, general way. Specific complaints are usually about constipation, with slight exaggeration, but they are never absurd or ridiculous. The patients usually wander aimlessly around, whining, unoccupied and apathetic. Sometimes there is mild restlessness, not accompanied by poor sleep, however, as in the benign cases. Organic insufficiency seems to have an invariably bad prognosis.

BENIGN CASES OF INVOLUTION MELANCHOLIA

Examination of Table 1 reveals some interesting data. Both death and poverty ideas and mild hypochondriac notions occur often, not infrequently dominating the clinical picture. In only one case (Case 26) were these fearful ideas expressed without anxiety, but this patient, on the other hand, sometimes showed affect. Some mention of severe hypochondria occurs eight times, but in four of these cases the remarks thus catalogued were occasional. Of these, three patients made such complaints only during a short episode, two of them showing at this period a special agitation. In one case (Case 4) the remarks were apparently similes rather than delusions, while in two more (Cases 27 and 43) it seems on reviewing the records that the patients may have been using comparisons rather than expressing convictions. In Case 8 the hypochondiac notions were sometimes delusions and sometimes only metaphorical. This patient and the patient in Case 43 were the only ones who frequently expressed these ideas and neither had a consistent and obvious belief in the fancied disability. In no case do we find well developed severe hypochondria to be a dominating, permanent symptom, so that we can assert that benign cases fail to show this common feature of involution melancholia prominently or consistently. The only patient (Case 8) who gave frequent utterance to unquestioned delusions of this nature was at the menopause. This deserves notice, as will appear later.

As to the behavior which we list under the heading of peevishness, only seven of the forty-three patients who had recovered showed symptoms of this nature, and in most of them it was confined to mere irritability; in only one (Case 43) was this more than an occasional phenomenon. It is interesting that only one in this series had a longer psychosis than this patient.

To summarize the material presented in Table 1, these patients showed marked emotional reaction, usually anxiety with restlessness, and they had prominent delusions of death and poverty. Peevishness and severe hypochondria were isolated symptoms which were never sufficiently well developed to be consistently dominant features in the psychosis. Patients began to recover after an average duration of nine

TABLE 1.—Recovered Cases

No.	Sex	Age	Emotional State	Death or Poverty Ideas	Mild Hypochondria	Severe Hypochondria	Peevishness	Improvement, Years	Recovery, Years	Varia
1	♀	47	Moaning, restless	++	+	......	......	7/12	1	
2	♂	46	Retardation	......	......	......	......	1/12	1/2	Typical manic depressive
3	♀	66	Retardation	......	......	......	......	3/12	5/12	Typical manic depressive
4	♀	64	Complaining	++	+	As similes only	......	1/2	3	
5	♂	68	Retardation	......	+	......	......	5/12	9/12	Typical manic depressive
6	♀	59	Retardation, then anxiety	++	......	......	......	3 3/4	4 1/4	Mixed manic depressive and involution
7	♂	56	Agitated anxiety	+++	......	......	......	4/12	8/12	
8	♀	48	Retardation, anxiety, fidgety	+++	......	++ often only similes	+	2/12	4/12	Menopause
9	♀	51	Retardation with spells of elation, sometimes apprehensive	+++	......	......	......	1 +	1 +	
10	♂	45	Dulness and anxiety	+	+	......	......	5/12	6/12	
11	♂	66	Retardation, restlessness	......	+	......	......	1 5/12	1 6/12	Manic depressive type
12	♀	61	Agitation and despair	+	......	......	......	10/12	1	Manic depressive type
13	♀	46	Apprehension, restlessness with some restraint	+	+	......	......	6/12	8/12	
14	♂	47	Retardation, inadequacy, self-blame	......	+	......	......	5/12	8/12	Typical manic depressive
15	♀	56	Apprehensive, restless, reticent	+	......	......	......	2/12	1	
16	♀	45	Inadequacy, guilt, apprehensive, episodic agitation	+	......	......	......	5/12	9/12	
17	♀	55	Fear, agitation	+++	......	+	......	10/12	1	Severe hypochondria, episodic
18	♀	49	Fearful, agitated	+	+	......	......	2/12	3	
19	♂	68	Dejected, listless, episode of agitation	+	......	+	......	1/5	1/3	Severe hypochondria, occasional during brief period of agitation
20	♀	54	Languid, complaining, agitation with hallucinatory episodes	+	+++	......	......	1 9/12	4	Recovered after manic episode
21	♂	63	Retarded, dejected, at times surly	+	++	......	+	3/12	6/12	Manic depressive type
22	♀	45	Varying retardation and apprehension	+	+	......	......	3 1/2	4	
23	♂	64	Hopeless, worrying, episode of agitation	+++	+	......	......	1	1 1/2	

24	♂	56	Restless, fretting......................	++	++	......	......	5/12	6/12	
25	♂	51	Retardation, negativistic..............	......	......	......	+	4/12	5/12	
26	♀	59	Aprehensive or calm....................	+++	+	......	......	4/12	3 1/2	Fearful ideas often expressed without affect
27	♂	61	Sad and hopeless, then apprehensive...	+++	+++	......	......	6/12	7/12	
28	♀	45	Crying, hopeless, inactive..............	......	+++	Idea that sex organs were shriveled up, may have been a simile	......	2	2 5/12	Menopause
29	♂	66	Hopeless, inadequacy, worry...........	......	++	......	......	4/12	6/12	
30	♀	50	Variable depression with worry and compulsive thoughts	......	+	......	......	Constant variation	5	
31	♀	46	Retarded, episode of mild stupor, depressive worrying	+	+	......	+	6/12	3	Content mainly self-accusations
32	♀	39	Distress with many somatic complaints	+	+++	......	+	5/12	7/12	
33	♀	52	Retardation, discouraged, a little restlessness	......	+	......	......	7/12	6	
34	♂	49	Periods of agitation, otherwise whining lassitude and feeling of inferiority	++	++	+	+	1 9/12	2 3/12	Severe hypochondria only once during a spell of agitation
35	♂	46	Discouraged, inadequacy...............	+	+	......	......	4/12	1 4/12	Manic depressive type
36	♀	42	Sad, gloomy, crying, slight restlessness	+++	......	......	......	5/12	6/12	
37	♀	58	Gloomy, worrying......................	++	+++	......	......	1 2/12	1 4/12	Two subsequent attacks with recovery
38	♂	54	Some inadequacy, feeling of sin and worry	++	+	......	......	7/12	1 3/12	
39	♀	50	Listless, retarded, occasional queer smile, at times fear	+	......	......	......	8/12	10/12	
40	♀	47	Mild retardation........................	......	......	......	......	5/12	1 7/12	Typical manic depressive
41	♀	51	Retardation with some restlessness....	+	......	+ transient	......	6/12	7/12	
42	♀	50	Crying depression, inadequacy.........	......	+++	......	......	3 8/12	4 3/12	
43	♀	48	Great restlessness with moaning and vague distress	+	+++	? ?	++	11/12	5	Frequent complaint that she could not swallow, may not have been meant literally

+ = Occasional.
++ = Frequent.
+++ = Dominating the clinical picture.
Manic depressive = Ordinary depression characterized by retardation with feelings of sadness, wickedness, inadequacy and unreality.

TABLE 2.—CHRONIC CASES

No.	Sex	Age	Emotional State	Death or Poverty Ideas	Mild Hypochondria	Severe Hypochondria or Autoerotism	Peevishness	Restriction of Interest or Affect	Improvement, Years	Chronic, Years	Varia
44	♀	63	Extreme irritability; mumbles to self; complains of fear	++	++	......	+++	......	12, following hemiplegia	14 Died	
45	♀	52	Tremendous agitation; later seclusive, apathetic, with irritable periods	......	......	+++	++	......	7 1/2	8	
46	♂	68	Unoccupied, insufficient affect..........	+	+++	......	......	Narrowing of mental horizon with shallow affect	......	12 Died	
47	♀	66	Restless, moaning, marked agitation, wants to be left alone	+++	......	+++	......	Usually insufficient affect	......	6 3/12 Died	
48	♀	56	Restless, moaning, distressed; episodes of great agitation	++	......	+++	++	......	......	8	Constant hallucinations of hearing
49	♂	64	Great retardation with sadness and feeling of unreality	......	......	......	......	......	2 10/12	7 Died	Typical manic-depressive but arteriosclerotic
50	♀	50	Constant restless fussing, peevishness and demand for attention	......	+++	+++	+++	......	......	18 6/12	
51	♀	59	Sometimes restless, constant stereotyped moaning and affectless complaints	+	+	......	......	Narrowing of mental horizon with shallow affect	......	11	
52	♀	43	At first retardation; later restless, apprehensive complaining; finally spells of irritability	+	......	+++	++	......	5	20	Prominent ideas of diminution
53	♀	60	Restless, distressed moaning, very uncommunicative	+++	......	+++	+++	......	3?	18 Died	
54	♀	48	Monotonous complaints, with shallow affect, except when delusions are questioned, then irritable	++	+	+++	+++	Shallow affect as a rule	......	5 Died	
55	♀	68	Three stages: (1) restless, hopeless, vague apprehension; (2) agitation one week; (3) chronic peevishness	+++ (for one week)	+	+	+++	......	......	6 Died	
56	♀	59	First, depressed; later, restless with shallow affect	+++	......	+++	+++	......	......	11 7/12 Died	
57	♀	54	Inadequacy onset; restless and vague fear; finally chronic moaning and complaining	++	+	+++	......	Narrowing of mental horizon	......	4 3/12 Died	
58	♂	56	(1) Worry and suspicion; (2) mild retardation; (3) chronic suspicion	+++	......	......	++	......	......	11 Died	Constant hallucinations and delusions of dementia praecox type
59	♂	54	Unoccupied, surly, seclusive............	......	+	+++	+++	......	......	4 2/12 deteriorated	Marked change of character 9 years before psychosis
60	♂	57	Worry, at times restless, at times subdued, chronic uneasy muttering	++	......	+++	......	......	......	9 6/12 Died	
61	♀	52	Restless, complaining, peevish.........	++	+	+++	+++	......	......	5 Died	
62	♂	60	Listless, slow but insufficient affect....	+++	......	+++	+	Insufficient affect	......	12 Died	
63	♀	52	Great restlessness, hair pulling, etc., with vague apprehension; later no affect, still restless	......	......	++	+++ with deterioration	Gradual loss of affect with narrowing of mental horizon	......	19	

and one half months, while recovery occurred from four months to six years after onset with an average total duration of twenty and one half months.

CHRONIC CASES OF INVOLUTION MELANCHOLIA

Table 2 shows a marked contrast in symptomatology. The cases recorded in this table are of those who did not recover during many years, the duration of the psychosis up to the last report being noted in the "Chronic Years" column. Included also are the cases of patients who died without having shown any sign of recovery within four years after the onset or who seemed to have reached a chronic state some years later. As has been explained, all those who recovered showed improvement within this period, so that one is justified in assuming that death terminated a chronic psychosis.

In general, the emotional states or behavior of the patients with malignant melancholia are different from those of patients with benign cases. Instead of frank fear reactions, there were much moaning, whining, seclusiveness, surliness and often insufficient affect. Restriction of interest or affect occurred in ten out of twenty cases. In each of these patients this loss was permanent, not subject to variations as in the patient in Case 26 who recovered, and it was always a prominent feature of the clinical picture.

About the same proportion of chronic and recovering cases show death or poverty ideas, and these are of the same type roughly, so that probably these ideas have no significance for prognosis.

A marked contrast is evident in the incidence of hypochondria, however. Roughly, three fourths of the patients with benign cases showed this symptom, but in only one sixth was it a dominant characteristic. Of the chronic cases, on the other hand, eighteen out of twenty made such complaints and of the two who did not, one had a case of pure manic-depressive depression complicated by arteriosclerosis (Case 49 [3]), so that one may say that hypochondria is almost always present in the more serious cases. It tends also to be more pronounced in its form, for in fourteen cases of the twenty it was a dominant symptom. The same tendency to exaggeration of interest in the body is evident in the frequency of severe hypochondria (an occasional symptom in the recovering patients) and of actual auto-

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[3] This patient showed some improvement nearly three years after the onset of his psychosis and might, of course, have eventually recovered had he lived. But since this improvement did not continue during the next four years, this seems unlikely. The case is included because it probably is one type of chronic psychosis—a benign reaction in which recovery is prevented by purely physical factors.

TABLE 3.—DOUBTFUL CASES

No.	Sex	Age	Emotional State	Death or Poverty Ideas	Mild Hypochondria	Severe Hypochondria or Autoerotism	Peevishness	Outcome	Varia
64	♀	53	Great restlessness......................	+	+	+++	+	Observed 14 months; discharged to another hospital; returned home "much improved" 3 2/12 years after onset	Menopause
65	♀	69	Retardation, then apprehension, then elation, then retardation and anxiety	+++	......	......	......	Improved after 2 years; then relapsed; 8 years after onset improved enough to be taken home from another hospital; 6 months later sister reported her well	Sexual ideas suggestive of dementia praecox
66	♀	49	Dejected, peevish......................	+	+	......	++	Observed for 6 months, then taken home; 4 years later husband reported she was well except for resentment at having been put in hospital	
67	♀	62	Great restlessness, with self-accusations; later, quieter with same ideas but uncommunicative	......	......	Constant analerotism	......	First improvement noted 2 years and 8 months after onset; well enough to go home 7 years after onset; not heard of since	

erotic practices, fifteen, or three quarters of the patients, manifesting this preoccupation; in thirteen of these it was a dominant symptom.

Another minor symptom in recovering patients which is prominent in this second group is the exaggeration of irritability which we speak of as peevishness; fourteen of the twenty showed it, and in these it was a dominant feature.

It is evident that the three symptoms of attention to the body, peevishness and restriction of interest or affect are definitely associated with a bad prognosis. Not one of these occurs as a persistent or dominant symptom in the recovering melancholias, while with two exceptions every patient with a fatal or chronic case showed one, two or all three of these malignant symptoms in marked form. The two exceptions rather go to prove this rule, for neither showed a typical picture of involution melancholia, one being a manic-depressive depression with arteriosclerosis and the other very much like the picture of a dementia praecox with constant delusions and hallucinations.

DOUBTFUL CASES OF INVOLUTION MELANCHOLIA

If these two tables included all our material, dogmatic statements might be allowable. Unfortunately, however, simplicity and rigidity of definition are rarely justified in psychiatry and this study of involution melancholia offers no exception. In Table 3 appear data which seem to render doubtful the finality of the foregoing conclusions. Four cases are represented here which were not placed in the first two tables because the question of complete recovery was settled merely by report from relatives. We would have been justified in eliminating these from the series, were it not that three of them might have been expected to develop chronic psychoses according to the foregoing criteria. Whether these patients recovered fully or not cannot be demonstrated, but this, for our present purposes, is not so important. They certainly improved enough to return home. Had they been thoroughly examined by a competent psychiatrist and found to have still some psychotic tendencies, this would mean little. Mild mental abnormalities are so frequent in old age as to be almost universal, so that our standard of normality, high for youth and middle age, must be lowered in considering cases of the senium. On purely theoretic grounds we might say that nearly all old people have symptoms of involution melancholia, with their worries about health and property of themselves and of their families, but practically, we are dealing with exaggerations of these tendencies which proceed to such development that the unfortunate ones become incompetent and intolerable burdens in the home. If then, a patient becomes well enough to return home and stay there, the presumption is that the accentuation of senile traits—the psychosis in this narrow sense—has disappeared. Let us consider these cases one by one.

The patient in Case 64 showed no insufficiency of affect, but there were constant complaints of the type which we have come to regard as malignant. She thought her rectum was broken off, that the urine came out of the wrong place, that nothing could pass to her stomach, etc. In addition she was occasionally peevish. She was, however, at the menopause. If one examines the two climacteric cases in Table 1, it is seen that these patients tend symptomatically toward the malignant type. For instance, the patient in Case 8 frequently indulged in extreme hypochondriac delusions and was sometimes peevish. The patient in Case 28 constantly complained that her sexual organs were shriveled up. These three patients, being at the menopause, constitute a small group, the members of which one might have expected to have chronic psychoses, who recovered or improved markedly. Although this group is small, the presence of demonstrable physical factors probably allows us to regard them as different from the usual patients with involution melancholia. It is not difficult to imagine that the endocrine disturbances of this period may facilitate a graver degree of mental disintegration than is possible without deterioration in normal physical health.

Case 65 is a complicated one, in which the patient had mood variations like those of a younger manic-depressive patient. She had many sexual delusions reminiscent of dementia praecox. She thought she had been made pregnant by her brother-in-law, that men visited her room at night; she also complained of vaginal sensations. Had she been 30 or 40 years younger one would not have hesitated to make a diagnosis of dementia praecox. It was not until she had been ill for eight and one-half years that she began to improve and was taken home. We have only her sister's word to support the belief in her recovery. It may well be that—at the age of 77—a senile or arteriosclerotic dementia wiped out the delusional and emotional symptoms. At any rate this patient's clinical picture did not coincide with that of involution melancholia, so that we are probably justified in disregarding it in our general conclusions.

Case 66 was that of a patient who was frequently peevish but who showed no other unusual or malignant symptoms. Her case was not included in Table 1 chiefly because the dates of her improvement and recovery were not known. Her continued resentment at having been placed in a hospital may have been merely indicative of a character change rather than of an unrecovered psychosis in the narrow sense.

Case 67 presents real difficulties. Self-accusations dominated the clinical picture with tremendous restlessness—a mixture, as it were, of manic-depressive depression and involution melancholia. For a long period she continued to smear feces over her clothing and even to pull them out of her rectum with her fingers. Later she became quiet and uncommunicative. By all our standards this patient should have remained in a state of deterioration, and it was with surprise that we learned of her improvement in a state hospital to which she was transferred, and of her removal to her home. No argument can explain this case. It remains, quite frankly, an exception. But in any series of sixty-seven psychiatric cases, is not at least one exception to general rules encountered?

COMPARISON OF DREYFUS' FINDINGS WITH THOSE OF AUTHORS

One is naturally interested in comparing the foregoing findings with the observations of Dreyfus. This is a difficult matter because data such as the exact nature of false ideas are not carefully noted in his case histories in many instances. Further, it must be remembered that his patients were under treatment at a time when melancholia was generally thought to be frequently a chronic disease, so that patients not showing early improvement were regarded as chronic and quite possibly observed superficially and at long intervals. This may account for the statements that the patients in Case 13 and Case 20 did not show signs of improvement until after eight and six years, respectively. In general, his material seems to follow the rules which we have deduced from the series here reported. The possible discrepancies alone deserve mention.

In Case 3 the patient complained for a month of being filled with feces and of being unable to defecate. Whether these ideas were qualified does not appear. At the end of the month doubt was admitted as to the validity of these complaints. We would probably have listed this case as showing an episode of bad hypochondria. The patient in Case 6 during a period of four months often smeared feces. One suspects, however, that the clinical picture was more like that of manic-depressive insanity than that of involution melancholia. No false ideas are reported; for one day, at least, elation was present. Smearing is, of course, a frequent symptom with manic patients, particularly with those who become absorbed in their unexpressed thoughts.

In his group of fatal cases no patient with fantastic hypochondriac delusions had recovered before death.

Most of the patients in his "not yet recovered" group were obviously on the way to normality.

One patient (Case 32), who apparently had the benign type of melancholia, developed arteriosclerotic dementia and had, therefore, a chronic case like that of the patient in our Case 49. In Case 31, although there were complications, the patient showed no definitely malignant symptoms and apparently recovered. Apparently she did not leave the hospital because she had become "institutionalized" as so many old people do, and was apprehensive of quitting that comfortable environment. The patient in Case 30 had only during the onset the delusion that her stomach was closed and that nothing could pass through it. After many variations in her clinical picture she began to recover three and one half years after onset and was apparently improving steadily when reported. This case we would classify as showing merely an episode of severe hypochondria. Case 29 is interesting. The patient showed for a year, while under observation, persistent and dominating hypochondriac delusions. She was then taken home. Eight years after the onset she was reexamined. She was still hypochondriac, was careless of herself and her home, did not go out, and had a feeling of insufficiency. This picture looks like that of chronic deterioration, yet Dreyfus calls it manic depressive insanity with hysterical tendencies!

In general, then, a review of Dreyfus' material gives us no urgent reason to doubt the validity of our conclusions.

A word should be said about the nosologic position of involution melancholia. This analysis of symptoms tends to throw the material into two groups. In one, with a good prognosis, there is as a rule, a strong affective reaction and the delusions are of the same order as those appearing in manic-depressive insanity. In the other, the patients deteriorate and show symptoms distinctly of the kind we associate with dementia praecox; the affect is apt to be insufficient, the behavior is auto-erotic and negativistic in the extreme, and the delusions are ridiculous, expressing perverse sexuality. Plainly, then, involution melancholia belongs in two markedly opposed psychiatric divisions. There are two ways of meeting this difficulty. It may be regarded as a separate division with a variable prognosis or as two related psychoses. In the latter case one would regard the benign melancholic psychoses as a type of manic-depressive reaction (like mania, depression, stupor, etc.) and the deteriorating psychoses as a type of dementia praecox. It is probable that individual taste is likely to determine the classification adopted by psychiatrists, at least for many years.

An argument in favor of looking on involution melancholia as a reaction type of manic-depressive insanity is found in the clinical pictures of many manic-depressive patients. Conditions of marked fear of death, of loss of property, or of moral destruction, with hypochondria but accompanied by no real sadness or retardation are common as episodes or as entire psychoses in persons of early as well as advanced years. If space permitted we could, for instance, detail the history of a patient, aged 33, whose case caused much difference of opinion as to diagnosis. He recovered completely. On reviewing the full and accurate notes of the case it appears that symptom for symptom the clinical picture was a duplicate of that of involution melancholia. Had he been twenty or thirty years older there would probably have been no confusion of opinion among those who observed him.

It is not within the scope of this report to discuss the psychology of involution melancholia. It may be remarked, however, that the regressive mechanisms of the malignant psychoses seem closely related to those of dementia praecox, while the analogy holds just as strongly between the psychology of benign cases and that of manic-depressive insanity.

One point should be mentioned of theoretic and, possibly, great practical importance. In both Dreyfus' and our own material it seems a rare event for a melancholic patient to recover fully while still in the hospital. The return to complete normality occurs at home in the patient's normal environment. This is in marked contrast to the phenomena of recovery in most cases of manic-depressive insanity, with the exception, perhaps, of the stupors.

SUMMARY

We may state the following as the result of our work: The results in a series of sixty-seven patients (summarized in Table 4, pp. 18-37) in whom the final outcome was determined in all but one case, cause us to conclude that patients with involution melancholia recover unless they show as dominant symptoms: marked insufficiency of affect, peevish or auto-erotic behavior, or ridiculous hypochondriac delusions which usually are concerned with the alimentary tract. These prognostically bad symptoms may be present for a short phase of the psychosis in women at the menopause without their prejudicing the outlook for recovery. All patients who eventually recover show some improvement within four years after the onset. The others run a chronic course or die unimproved.

TABLE 4.—CASES—

Case No.	Age	Previous Attacks	Emotional State	Death Ideas	Other Apprehensive Ideas	Self-Accusation	Unreality	Negation	Severe Hypochondria
1	47	0	Restless, moaning	Suicidal attempt	People plot against her	....	....	....	....
			Restless	....	Will be taken away	....	....	....	....
2	46	1	Gloomy, unoccupied; sometimes restless; marked inadequacy	....	Worries over inadequacy; will not get well; what will become of family?	Blames self for condition	....	....	....
3	66	4+*	Unoccupied; inadequacy with slight restlessness	....	Nothing to live for; fears losing mind; worry over condition	....	....	....	....
4	64	0	Unoccupied; fussy manner and complaining	I will be dead tomorrow	....	....	....	No cars running; no fire, no water, no clothes	No room for food; no stomach; does not urinate; all as similes, not actual delusions
5	68	1	Inadequacy; dejected	....	Will not recover; worry over condition; wife will come to want	....	....	....	....
6	59	0	Inadequate for her work	....	Losing her mind	Killed husband by her jealousy; not religious enough; will be taken to court	....	....	....
			Depressed two weeks	....	Will not get well				
			Sometimes restlessness; worry, jealous of husband and friend, ashamed of it; "mixed up," "I change my mind so often"	Will be killed, hanged, for killing husband	Husband dead				
			Much distress	Will be buried alive; will be put in dark place, death tonight and terrible punishment, ideas of reference in connection with death; putting flowers in water means will be drowned, etc.	Home broken up, husband has remarried; in prison	Terrible thoughts of people, poisoning, etc.; feels responsible for them	....	....	....
7	56	2	Agitation, wringing hands, tense, anxious, suspicious (tastes food); indefinite dread	Fears poison	Will go to ruin; everybody against him; indefinite dread of something to happen	Has not done business well	....	....	....
			Two weeks: more agitated, shouting, breaking glass, throwing furniture	Nurses going to put him under ground, going to burn him, going to murder him					
			Quieter, still suspicious and having feeling of dread						
8	48	0	Inadequacy, retardation, some fear, fidgety	Place in hell for her	....	....	Real world? real people? suspended in space; everything elongated and enlarged	....	No stomach, no mouth, no head, "shrunk up," no opening to body, does not breathe through nose; (only similes when criticized)
9	51	1	Depressed; retarded; exhilarated spells	Fear of burning, dogs will eat her, may be hanged or dissected	....	....	....	....	....

* Manic circular.

Mild Hypochondria	Analerotism	Autoerotism	Irritability, Peevishness	Adult Sexuality	Poverty Ideas	Sleep	Varia
....	....	....	....	Husband untrue; later he accuses her of infidelity	Will be poor	....	Begins with menopause
Epigastric uneasiness	....	Picking fingers	....	....	Idea of poverty		
....	....	....	....	....	Worry over expenses	Poor sleep when restless	
Pressure in the head	No passage down her throat; nothing passes her; both as similes	Picking fingers	....	....	No money to stay here; no money to buy clothes	Marked insomnia	
Burning sensation and pains through limbs	....	....	Complains about conditions on ward	....	....	Poor	
....	....	....	....	....	....	....	Sister's throat is cut
....	....	....	....	....	....	....	Attacks of indigestion; heightened blood pressure also some months after discharge
....	....	....	Spat food out of mouth, knocked dish out of nurse's hand; quarrel over trifles	....	No money, no clothes, poverty, scared about luxuriousness; refuses food because cannot pay; later because no stomach		
....	....	....	....	....	....	Mild sleeplessness	

TABLE 4.—Cases Studied—

Case No.	Age	Previous Attacks	Emotional State	Death Ideas	Other Apprehensive Ideas	Self-Accusation	Unreality	Negation	Severe Hypochondria
10	45	0	Rather dull, not retarded; apprehensive	....	Something terrible might happen; people waiting outside; will be arrested	Thought “somebody might have led me astray”	....	....	....
11	66	2	Marked inadequacy, with some restlessness	....	....	Never amounted to anything, did not take enough interest; degenerate; never had a decent trait	No affection	....	....
12	61	1	In despair, colossal restlessness, moaning, rocking	Something is going to destroy her; markedly suicidal	Going to lose her mind; frightful thoughts	“I have wrecked their lives, killed them all, shall lose my mind and it is my fault”	“Can't sympathize, can't enjoy”	....	....
13	46	0	Worried, restless, apprehensive	Fears will be tortured	Something dreadful will happen	....	....	....	....
			Restlessness, with immobile face, certain constraint, slow in answering questions referring to her worry	Will be cut up	Afraid will be punished; police waiting; will be harmed	Disgraced sister; said she stole from employer; then “not guilty,” never did any harm			
14	47	3	Depressed, dull, inadequacy	....	No hope, no salvation	Defaulted money; no salvation, people know his real character	....	....	....
15	56	1	Restless, hard to say what she worries about, “mixed up”	“Are they going to kill me?”	Fears poison and reading of her letters; worry about home and children	Is wicked	....	....	....
16	45	2	Inadequacy, guilt, episodic agitation	Suicidal	Family branded for life; prison; something will happen to husband: arrested; police spies about	....	....	....	....
17	55	3	Depressed, listless	Going to die	Dreadful calamity	....	“Sometimes think I am not alive, I have so little feeling for others”	....	Contagious disease; would infect everybody by unclean breath; depopulate cities; daughter lost position and husband hanged on account of odor; stomach does not work, a hollow there
			Often marked restlessness and moaning	Will be thrown on dump, naked, torn to pieces, head cut off, eyes dug out, murdered, tortured; husband torn up	Poison in food; vitriol in wash water				
18	49	0	Marked restlessness, whining, wailing, especially in spells, looking very distressed; complaints of being “all discouraged”	....	Feeling as if world were going to fail on her: mind going, “will be like my father” (bad melancholia)	....	....	....	....
19	68	1	Dejected	Onset: will die, last day on earth	Onset: arrested; house will fall down	Has done much harm, dishonest	....	Has destroyed the world; no life	For five days: substance all gone, stomach full of corruption. This with agitation, broken sentences and confusion

Mild Hypochondria	Analerotism	Autoerotism	Irritability. Peevishness	Adult Sexuality	Poverty Ideas	Sleep	Varia
....	....	....	....	....	"Money gone"	Good sleep	
Pins and ants in extremities; crawling feeling all over, throbbing feeling in chest, fullness in abdomen	....	....	....	....	....	Some sleeplessness	
Agony sensations in head	....	....	....	....	....	Fair as a rule; occasionally very little sleep	
A terrible strain about the heart	....	....	....	....	In poverty, will be put on street	Poor sleep at first only	
Pinched feeling in head							
....	....	Picking and biting nails	....	....	No money; will starve		
Distress in head							
Indigestion; stomach burns	Food is urine; the tube by which fed is rectal tube	....	....	....	....	Insomnia	Severe hypochondria, merely episodic
Peculiar aches in legs and hands, with a desire to move, also "emotional suffering feeling"	....	....	....	....	Money going		
....	....	....	....	....	....	Good sleep	

TABLE 4.—CASES STUDIED—

Case No.	Age	Previous Attacks	Emotional State	Death Ideas	Other Apprehensive Ideas	Self-Accusation	Unreality	Negation	Severe Hypochondria
20	54	0	Languid, tired	....	Mental powers gone; won't get better; sister insane, will be blind, will be electrocuted for killing somebody; completely mad in a way never heard of—like a mad dog	Why was I born? Am I to blame?	....	....	Burning up; worms crawling over her
			Sudden marked restlessness, distress, even fear, suffering, excitement	Devil said he would murder her; she will be electrocuted					
			Quiet, marked depression, crying occasionally; gradually hopeful but anxiety about sister						
21	63	4	Retarded; sometimes restless, often surly	Gang waiting to kill him (once)	Things going wrong at home; has been ruined by syphilis	....	....	....	....
22	45	0	Marked restlessness with unequal retardation	....	Will be tried; something will happen to husband and children	Killed husband, children and sister	....	....	....
23	64	1	Lethargy, worry, depression, restlessness, hopeless of recovery Depression, but occupation and better evenings	....	Never get well, what will happen to family?	....	....	....	....
			Two days stirred up, reticent, suspicious, began at night suddenly when he got restless "to be kept for life"	Will be used for vivisection	Will be tortured, will be experimented on; yet says himself ideas are wild, though not losing suspiciousness				
			Improvement 1 month, though still gloomy without special ideas	....	Never get well				
			Depressed, languid, indifferent but can smile	....	Apprehensive but not without insight; will be left on street; at police station; it will kill his family, etc.				
24	56	1	Restless, moderate fretting over trifles	....	Afraid of becoming insane	....	....	....	....
25	51	4	Retardation, negativistic (probably result of suspiciousness)	....	....	....	....	....	....
26	59	0	Worried, restless, anxious	Will be cremated, crushed to death	Put in dark hole, will be burned, put in lake of fire; wild animals tear her to pieces; also delusional interpretations of things heard	....	....	....	....
			Sometimes composed, speaking of apprehensive ideas, often guilt, anxious and appealing to physician						
			After three weeks, following visit of husband, sudden improvement, henceforth variations						
27	61	1	Depressed, hopeless, then apprehensive	Will be killed, burned, drowned, strangled	Will never recover	Ought to be an outcast	....	....	....
28	45	0	Depressed, cried; said had no ambition	....	....	....	No interest, no affection for family: does not care about appearance; sleep unnatural; ability to appreciate is dulled; pain sensations and touch different; no natural feeling in head	....	Sex organs shriveled up (simile?)
			Unoccupied, lack of energy, especially in forenoon, better evenings, much bitter crying						
29	66	0	Typical inadequacy feeling of awful depression; worry	....	....	Life a failure; neglectful of duties	....	....	....

Mild Hypochondria	Anal-erotism	Auto-erotism	Irritability, Peevishness	Adult Sexuality	Poverty Ideas	Sleep	Varia
Burning skin, pain in back, sore muscles, nerves tingling, "all gone" in stomach, mind weak	......	......	....	....	....	Fair sleep	"Worms crawling over her," probably a death idea
Pain in abdomen, gas in bowels, nose dry, does not sleep	......	......	Often surly	....	Family extravagant	"Does not sleep"	
....	......	......	....	Onset: calls herself whore because she exposed herself in tearing clothes; stayed in bed and attracted men			
Prickly sensation in body, head, knees and forearm	......	......	....	....	Property to be taken to defray expenses of keeping him in asylum and family will be destitute; money going; when all gone will be turned in street	At first fair, later excellent sleep	
Epigastric sensation; disease of lungs	......	......	....	....	Family are paupers, daughter going to poorhouse	Considerable insomnia	
....	......	Picking of fingers	Frequently negativistic				
Disagreeable sensation in feet and hands	......	......	....	....	....	Poor sleep	
Syphilis of throat (had syphilis in youth)	......	......	....	....	Poorhouse		
Empty feeling in stomach as if food did not reach bottom; loss of sexual feeling and of all sensations	......	......	....	"Sexual organs shriveled up"; attributes this to coitus interruptus. Sex feeling gone, petrified clitoris also accounts for lack of energy	....	Usually quite poor sleep	Dry skin and lack of perspiration in hot bath
Dyspepsia, cannot sleep, smothering sensation	......	......	....	....	....	"Can't sleep"	

Case No.	Age	Previous Attacks	Emotional State	Death Ideas	Other Apprehensive Ideas	Self-Accusation	Unreality	Negation
30	50	4	Constant variations; quiet, some inadequacy, slightly depressed; worry; compulsive thoughts	....	....	Innumerable trivialities	Things do not look quite natural; cannot cry; feels as if turned into stone	....
31	46	2	Much retardation at first, also stupor symptoms, gradually freer, sometimes somewhat restless; agitated with self-accusations	Ought to die, cannot die	Has to pay for everything	(When freer) the vilest wretch, has dragged family into poverty, has terrible disease	....	....
32	39	0	Gradual neglect of work and appearance; attacks of restlessness with marked sensations, writhing, pinching herself, pulling mouth out of shape, crying for help, "do something"	Onset: Asks to be killed; fears suffocation; is afraid will be put into a box	Is afraid will have a fit, a stroke or go insane	....	....	Family all dead
			Intense restlessness, gradually diminishing with great distress; constant sensations					
33	52	1	Moderate retardation, sometimes slight restlessness with "suffering"	....	She and daughter will be punished	Misappropriated money	....	....
			Very melancholy without content but great taedium vitae					
34	49	0	Depressed, gradual improvement	Attempted suicide	Never get well			
			Sudden agitation, cannot swallow food, everybody dead, etc. Unoccupied, whining, discomfort, distress, and weak apprehension, much lassitude and feeling of inferiority	Will never die, will be left on earth alone (as punishment for misdeeds); voices say he will be taken into dark, broken on stones; thought he would be boiled when some one said "lobster"	Will be put on a paralytic's water bed; people here have their teeth knocked out Human bodies ground up downstairs; this with strangeness of things made him think buildings were made of suffering human bodies; also that food and wicker chairs were flesh; ideas of reference	"Why am I so wicked? I don't want to do such a dreadful thing"	(Retrospective) everything seemed unreal; there seemed general dissolution; everything changed—room bigger	Everybody dead; no newspapers; no countries; fields not worked, seasons too short for crops to ripen; time shorter; no cars running; all business stopped; wife not real (because he thought she was dead); no one eats or sleeps
35	46	0*	Quiet, inadequacy, discouraged	....	Everything looks bad; borrows trouble	Ought to be ashamed of himself	....	....
36	42	0	Dread constantly complained of, especially marked at night; moderate restlessness shown in picking, some crying; sad gloomy appearance	Fears she will die before night; food poisoned; going to be cut up; four men will kill her	Fears something may happen to husband or son; poison in food; to be taken away at night; her teeth will be extracted; all to be burned; husband to be killed; wind signifies this; toast passed in queer way means she wants to kill husband with toast; tea brought to her while husband is there means she is going to kill him and it is to brace her up, etc.	Cross stitches mean to keep the cross before her; odd things others say are to impersonate her so that she is blamed	....	....
37	58	0	Gloomy, worrying	....	....	....	....	....

* Depressive makeup.

Intense Hypochondria	Mild Hypochondria	Anal-erotism	Auto-erotism	Irritability, Peevishness	Adult Sexuality	Poverty Ideas	Sleep	Varia
....	Epigastric uneasiness	....	......	....	Sexual feeling when another (female) patient touched her breasts			
....	Has terrible disease	....	Wets and soils	Resistive to treatment	....	Dragged family into poverty	......	Pregnant at entrance
....	Throat full as if contracted, as though some one were grasping it; as though eyes were coming out of socket, as though tongue was pulled down, palate swollen; numbness and pricking in jaw and throat (inside); feels as though hollow way down through (outside); numbness all over as though dying; prickly all over; stomach discomfort; head: fullness, big as a drum, something boiling in it all the time; band sensation, numb	....	......	Struck, scratched and kicked nurses	....	......	Sleep disturbeb at first	Improved as she understood sensations had not significance she ascribed to them
....	Throat filled up; stomach growing up	....	......	....	....	......	......	Everybody knows her thoughts because things happen when she thinks of them
Cannot swallow, anus "stopped up" (complaints occurred only during one spell of agitation)	Pains all over body; lets himself fall, says he is too weak to get up; afraid of falling and breaking in pieces	...	......	Often desires not to be disturbed; begs to be left in his room; whining with skewed up face; often has to be dressed	... .	Worry over money	Poor sleep	
....	Head heavy	....	......	....	....	His people will come to want	Sleep, good	
....	For year fussing over stomach trouble, idea of cancer or heart disease	....	......	....	....	......	Poor sleep	
....	Constant fear of going blind, also thought was growing deaf or paralyzed	....	......	....	....	Cannot pay bills	Irregular	Two subsequent attacks with recovery

TABLE 4.—Cases Studied—

Case No.	Age	Previous Attacks	Emotional State	Death Ideas	Other Apprehensive Ideas	Self-Accusation	Unreality	Negation	Severe Hypochondria
38	54	0	Mild restlessness, some inadequacy, feeling of sin and worry	No right on earth	Soul is lost, has committed unforgivable sin, is in devil's power	Sinner, unpardonable sin, lost self-control, touched his wife's genitals	Spirit taken out; does not worry enough about family	....	....
39	50	1	Listless, retardation, occasional queer smiles; sometimes fear	Speaks of leaving the world soon	Something dreadful going to happen; microbes on her	Contaminates people with microbes	....	....	....
40	47	2	Mild retardation	....	....	Very wicked but cannot be made to say what she worries about	....	....	....
41	51	0	Restless with inadequacy	Going to die	Afraid will be taken away	....	....	....	Transient during onset: throat closing up
42	50	2	Depressed, inadequacy, somewhat agitated, crying	....	Will never get well; mind failing; teeth decaying; hair falling out	....	....	....	....
43	48	2	Restless, moaning, marked agitation, will not answer questions, wants to be left alone	....	Something dreadful to happen; hopeless condition; asks to be protected	....	....	....	Throat comes together so that cannot swallow
44	63	0	Dull and restless	Will be blown up with dynamite	....	....	....	....	....
			Extreme irritability; sometimes complaints of fear	"Come and cut my head off"	Put on street, never see daughter again; dominated by fear of being left alone	....	....	....	....
45	52	0	Worry, then outbreaks of agitation Tremendous agitation, with aimless acts, running about; later seclusive with periods of apathy and irritability	....	....	....	....	No one about her, is a dressed up form; a wilderness; no daughter, no husband; (orientation?) "I don't know anything about it"	No heart, mouth, stomach, pulse
46	68	0	Depressed, agitated spells, again natural	Suicidal tendency	Soul lost	....	....	....	....
			Dull depression; feeling of going to pieces; apathy	Can't die	Apprehensive ideas about harm to daughter and son-in-law				
47	66	0	Worry over things said and expenses Restless, moaning, afraid in spells, otherwise quiet; moaning, worried, with insufficient affect	....	Police coming, people waiting to take her; food poisoned Carriage to take her to funeral or wedding House falling to pieces	....	....	No water about, no home, "no anything"	Odor from her flesh; cannot pass feces or urine; bowels coming out; urine is more blood than urine

Mild Hypochondria	Analerotism	Autoerotism	Irritability, Peevishness	Adult Sexuality	Poverty Ideas	Sleep	Varia
Precordial sensations	....	....	....	....	Will lose everything and go to poorhouse	Good sleep	Ideas of reference; e. g., spoons rap when he does not eat well; attributed to higher power and to others
Heart disease; afraid of cancer; again pregnant	....	....	....	Claims assault and pregnancy; again cancer	....	Poor at first only	
Teeth decaying; hair falling out	....	....	Fussing about eating	....	....	Usually good	
Choking sensation in throat, cannot swallow, can hardly breathe	....	....	Peevish, complaint about no treatment, wants to be left alone	....	Worry over financial affairs		
....	....	....	....	....	All property lost		
Bad feeling all over, throat dry, stomach on fire; feels full and stopped up	....	....	Peevishness with dissatisfaction, irritability; hit nurses, threw furniture; surly expression, swore, very obscene	....	....	Poor sleep	Spelling words backward and constant mumbling; improved after a stroke
....	(After three years) may urinate anywhere	....	Assaultive at times; always irritable; often resented treatment	....	....	Sleep, sometimes good, sometimes bad	
Lack of nutrition owing to poor teeth; semen oozing all the time from him	Stomach full, crowded by bowels (no physical basis)	....	....	....	Patients took his money, will be destitute	Insomnia	Constant narrowing of mental horizon and insufficiency of affect
....	Soiled, refused to go to closet, "bowels don't move," "they are coming out"	Marked tendency to strip	....	Fear of men coming into room to assault her. Letter sent to say she is a bad woman	Worry over expenses; bills can't be paid; thousands expended on her. No clothes, no home	Poor sleep	

TABLE 4.—CASES STUDIED—

Case No.	Age	Previous Attacks	Emotional State	Death Ideas	Other Apprehensive Ideas	Self-Accusation	Unreality	Negation
48	56	0	Inactivity; depression Restless; distressed Spells of blind excitement, with intense distress and fear (sex content) Moaning, frightened, still sexual, also hypochondriac; intention paralysis	Can never be killed Will be killed or burned	....	....	Body different; everything gone except seeing and knowing Patient says to her "recede," "elongate," and then she shrinks up; complains of periods when everything looks queer	....
49	64	7	Played out; restless Quiet, retarded, immobile, has to be dressed, etc.	....	....	Worst man in world	Everything is wrong, nothing is right	....
50	50	1	Worry over condition Marked restlessness, fussed up, constant demands for attention	....	Harm coming to husband and self	....	....	....
51	59	0	Easily fatigued, worry. Standing, walking restlessly, moaning much; marked narrowing of mental horizon; affect seems sterotyped and shallow	Cut up	Heating apparatus will explode; prison; ruined; exposed on street in glass case; terrible thing to happen; dear ones in the cold, etc.	....	....	....
52	43	1	Depressed, retarded; moderate restlessness; suicidal, almost mute, with decided restlessness Moderate restlessness with freer speech; apprehensive; finally spells of irritability	Cannot die, (repeated attempts at suicide); asks if he will be hanged	"I am afraid"	Wicked, responsible for all wickedness in world; made all my people sin, lost my soul	"No life in me, seems as if my limbs were dead"; body different; throat not right; things do not look right, are larger	....
53	60	0	Distressed, dejected, moaning, restless, some perplexity	Can't live or die	"Afraid of everything," feeling of responsibility about everything	"Have lived on false pretenses"	....	....
54	48	1?	Nervous, crying, then "I changed in one night when all my power was taken away"; much depressed, in utter despair; later shallow affect except when delusions questioned, then irritable	Tried suicide; can't die; asks to be cut up and put in bottle	Will never get well, no use to anybody; legs numb and paralyzed, dead	"God changed me and I don't know why"	Shriveled up, face drawn up, mouth shrinking; entirely dissolved, only an image, dead; only a ball of wire, only a little ball, grown blind; "I think only when I speak and when I stop speaking there is not a thought in my head"	....

—BY AUTHORS—(*Continued*)

Intense Hypochondria	Mild Hypochondria	Anal-erotism	Auto-erotism	Irritability, Peevishness	Adult Sexuality	Poverty Ideas	Sleep	Varia
Stomach gone; is only a shell; can't walk; will be blind; can never get killed; body different, no bones; can't breathe; everything gone except seeing and knowing; shrinks up	Head feels hardened, feels as if she could not breathe on account of blocking in throat	Incontinence during limp spells	Strips at bidding of voices	Kicked, bit, struck in episodes associated with great excitement; later struggled against tube feeding, then relaxed and urinated on floor	Hears man, hypnotized, sexual commands, feels vaginal sensations; frequent stripping and coming into hall naked	......	Insomnia	Constant hallucinations of voices
....	Head not right, "sad all over, have not been made right"	....	....	....	....	......	Good sleep	Arteriosclerotic
Can't hear or see; is dead, (occasionally) hands stiff; can't breathe through nose	Pain, discomforts, hands stiff, heavy feeling in neck; will have cancer	Bowel trouble	Much shameless masturbation and occasional wetting; talks to self, "Why don't you get out of the window dearie?" "Don't you want to see how you look?"	Constant fault-finding; sometimes aggressive, violent to nurses with irritation, constant demands for attention	Exposes herself			
....	Leprosy	....	....	....	....	Ideas of poverty	Irregular	
Body different, throat not right, tongue too large	....	Untidy	....	Spells of irritability				
She has only two hands and feet; flesh not right, no body, getting smaller and smaller, drawing up, various sensations (touching face) make her smaller, "everything looks big"								
Rotten through and through, mouth gone, tongue swallowed, neck broken, throat broken by feeding, looks very old, feet are dead and he can't walk	....	Wilful bed wetting	....	Sometimes resistance and distinct desire to be left alone; pronounced muscular negativism; more and more nothing could be obtained from her	....	No money, a pauper	Insomnia at times	
Stomach and bowels grown up, brain turned to bone; organs of abdomen crowding in chest, entirely dissolved; only a ball of wire, a rag doll, a rat, a bit of lip, etc.	Legs numb and paralyzed	....	Pulls at lip until it is deformed	Highly irritable when ideas are questioned	....	......	Insomnia at onset	

Case No.	Age	Previous Attacks	Emotional State	Death Ideas	Other Apprehensive Ideas	Self-Accusation	Unreality	Negation
55	68	*	Depression, restless, worry over condition	....	"I shall go to pieces, I feel so badly"	....	......	....
			Restless movements, looks worried, craving sympathy, moaning					
			One week of intense agitation, not even time to eat properly, shouting "murder"	Will be burned, tortured, furnace ready, cremated, can read it in faces about him	....	....	......	....
			Only slightly restless but very fault finding; no ideas	....	Will not get well but owing to bad treatment			
56	59	0	Depressed, inactive	....	"I am crazy; I will kill myself"	Reproach for not having cared better for son	......	....
			Gradual restlessness but shallow affect with delusions of violent death	Will be poisoned; will be thrown out of window; cannot die	Will be put in dungeon with crazy man; "You are going to crush the life out of me," will be thrown out of window, into a cellar, heavy chains rattle which will be put on her	"They say I have killed my boy by giving him strychnin, but I did not do it, the doctor did it"	......	....
57	54	1	Onset with inadequacy, then restless writhing; gradually more monotonous affect and narrowed interests	Will be suffocated, buried alive, isolated	....	....	......	....
58	56	1	Makeup: apprehensive about health; since 14 nervous dyspepsia, often thought he was going to die; for twenty years had to have wife constantly with him even on business trips; hypersensitive and retiring	....	....	....	......	....
			Worry, anxious Two weeks: languid, slow action, never constant; moderate restlessness, moaning. decided suicidal tendency, some suspiciousness. One year: unoccupied, restless, then settled down; sometimes perplexed expression; suspicious watching. and tendency to withhold information, feeling of mental restriction and that he does not understand what things mean	Suicidal ideas, going to be killed tonight; thought he was dying because his hands felt numb; egg-nog makes him feel numb, and he does not want to die without his senses	Indefinite dread of something to happen; thought incorrectly written check scheme to injure him and family; conspiracy, spies Afraid to take bath; after refusal thinks friends are sacrificed in his stead. Friends being killed; they don't get home; ditches in garden are made for them; wife dead; all non-Catholics destroyed	....	......	"My friends are destroyed. The world destroyed. Voices say the world was taken out of its axis; there will never be another world"
			Then chronic hallucinations and delusions with insufficient affect and perfect orientation	Many ideas about self and others being killed, world destroyed, etc.	Feeling of significance which he does not understand. "There is a clearly definite movement and I am the only one who does not understand its significance or when to move." His actions prescribed; his life surrounded; occurrences have meaning; appliances and machinery destroying friends and world; mind reading and double thinking. "Why do you keep putting men from South Africa, South America and South United States into holes in the ground? Why do you take them to the attic and shoot them down the chutes?"	....	......	....

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* Many for ten years.

Severe Hypochondria	Mild Hypochondria	Anal-erotism	Auto-erotism	Irritability, Peevishness	Adult Sexuality	Poverty Ideas	Sleep	Varia
.... Feet are mortifying	Throbbing sensation in head	For years afraid of soiled things, ashes and dust, and afraid she might step in something that was not right	....	....	"It will kill my brother when he hears what the cause of my disease is, The people will think my disease is of a private nature. I brought the disease on myself; law says, 'Thou shalt not lust' "	......	Always insomnia	
....	....	....	....	Very fault finding, peevish, irritable; treatment, food, etc., bad				
....	....	....	....	....	....	......	Usually very poor	
Bones and neck broken; throat dead; odor from it; dead inside because cats and crows are after her; bowels ruptured fifteen years ago, mortification stuff spreads from them, air is full of it; this has caused a railroad accident and death of her boy, is making every one crazy; other patients are mortifying; has hydrophobia; is an animal	....	....	....	Peevish, chafing, petulant at times, irritable to nurses yelling at them when prevented in her restlessness from disturbing them				
Can't eat, can't swallow; food does not go to stomach	Will be blind; things blurred before her eyes	....	....	....	....	......	Marked insomnia	
....	....	....	....	....	....	......	Irregular, usually poor	
....	Head does not work well	....	....	At times very interfering and troublesome	....	"Have I been stripped of my property?"	......	Expansive ideas; voices say "He ruled the world and all the people in it. He settled the world." When he eats they say "He eats a king, a queen, a prince." When he took something out of a candy box, "He is eating his children"
....	......	......	....	....	....	......	......	Hallucinations and delusions of dementia praecox type

TABLE 4.—CASES STUDIED—

Case No.	Age	Previous Attacks	Emotional State	Death Ideas	Other Apprehensive Ideas	Self-Accusation	Unreality	Negation
59	64	3	Curled up in room; surly expression, certain restlessness, totally unoccupied, untidy	....	Afraid of harm; conspiracy to give him "pox"	....	....	"They say this is a hospital"
60	57	0	Worry, ruined self by taking poison, uneasy, restless, will be taken to court, family, etc., will be indicted Quiet, subdued Restlessness Restlessness more marked; "O God, I have to get out of here" Restless, much worried; had to get out; everything troubled him but could not describe it; finally chronic muttering	Attempted suicide (oxalic acid); going to be hanged	Held here for criminal trial "will astonish everybody." Something with post office All gone, "O God, O God, the whole business is gone, it is awful, awful, all gone to pieces"	....	....	......
61	52	0	Nervous, hypochondriac Marked restlessness, talking incessantly, repeating words and sentences; gradually more exclusively interested in hypochondriac ideas, with irritability when questioned	Will be buried alive	Will be tried for crime of which she feels innocent; refused food at first because covered with poison, later because organs are gone	....	....	......
62	60	2	Depressed about business Inactive, gloomy, listless, slow in speech and act, "I have no life, no force" No restlessness, same listlessness and inactivity, pauses in speech, decidedly apprehensive ideas but accepts these hopelessly and resignedly; insufficient affect throughout	Will be killed in various horrible ways	Ruined fiancée's life; certain forebodings not crystallized "They are coming to take me away." Heard team drive up in night, knew family in it, dead, and they would get him when they came back (hallucinations); going to be killed, "and then voices came and called my name." Will be burned in furnace, new one to be built because old one filled with ashes of dead men, "enough men for a month." Cut up in a machine, killed by electricity, thrown down a hopper lined with knives; conspiracy to destroy him and friends and others; mentions two men who he thinks have already been killed; gases collecting inside him and when they accumulate he will explode	"It seems as though all my life the mainspring of my actions was not right." Has been selfish all his life but was not so bad as people thought	....	......

Severe Hypochondria	Mild Hypochondria	Anal-erotism	Auto-erotism	Irritability, Peevishness	Adult Sexuality	Poverty Ideas	Sleep	Varia
Is rotten, odor from him smells up everything	Has "pox"	Filthy	Much masturbation	Objects to everything, sneering manner at examination; surly expression	......	....	Poor sleep at first	
....	Pain in head	Smears, will fill toilet or pipes if he goes to water closet (worry of expense stopped when this came); had diarrhea and tried to defecate all over place so as not to fill up pipes; complained often of being covered with feces; throughout tendency to defecate and urinate on floor	Rubs head or buttocks	....	......	The bills are not paid; they must be running up into the thousands; did not eat on account of expense	Insomnia	Always poor performance with intellectual test
Organs gone, therefore can't eat; heart stopped beating, all bones broken; only 16 years old; only 3 feet high; no heart; no organs, they passed out in her stools and filled the cesspool; bowels broken; burning sensation all over body which makes her strip constantly, attributed to poison put in bed by nurses	Burning sensation all over; worried about heart disease	Will not go to closet; digs out her feces	Strips constantl	Whining, petulant tone, with much irritability; can also be made to smile at times; complains of this awful treatment (poison put in her bed by nurses)	......	....	Fair sleep	
No room for food, gases collect inside; further accumulation will make him explode; disagreeable gases come from him	No life; no force	....	....	Refusal of food	......	Lost all property; has tangled up estate entrusted to him and will never be able to settle it; hospital people will take all his property away	Good	

Case No.	Age	Previous Attacks	Emotional State	Death Ideas	Other Apprehensive Ideas	Self-Accusation	Unreality	Negation
63	52	0	Lost interest, restless, more so when husband goes away; duller, in bed; ideas	....	Will be arrested, "Don't take me down there"	Wicked, had not treated husband right, to be arrested; inadequately formulated guilt; did wrong in coming here, being here, etc. "Don't think I am insane, I am not." "I was thinking I would tell you why I came and what I did to my brother-in-law and sister." "I was going to tell you of my coming here, I ought to have told you, I knew I was doing wrong but I kept on staying."	....	......
			Marked restlessness, pulling out of hair or motions of hands, considerable distress; unchanging expression, at times puzzled (exophthalmic goiter); little spontaneous talk, slowness in answers; later free, "My thoughts are not on it" to questions; finally practically no affect and stereotyped talk about going home or being in hospital			"I want to confess, my people are innocent and I am guilty (repeatedly), can't seem to tell what I worry about; it seems gone from me now; I have put it off so long that now I can't tell, I have forgotten."		
64	53	0	Restlessness, so that feet get swollen	"If I can live without eating, can't die, can't even be killed"	Something may happen to son	....	Hands feel different, no feeling in them; entirely different from any one else	......
65	69	0	Languid, sad	....	....	....	....	......
			Retardation, shame (sexual), and mildly apprehensive	Will be killed, brother will be killed; she will be put into dark hole	House will tumble, last meal	Is bad	....	......
			Apprehensive	Same	....	....	....	......
			Exhilaration, volubility, slight flight	None	None	....	....	......
			Well behaved					
			Gradual return of apprehensive ideas, restless, moaning and depressed	Will be killed	Will be tortured; she and family will be put into black hole	Has done dreadful things	....	......
66	49	0	Gloomy depression, peevish	Onset: will be hanged; later, "Let me die." or "Why don't you chop me up?"	Electricity, poison in food. "I suppose I have to go to jail." Ideas of reference about objects	Projected; accused of being hypocrite, thief, prostitute, living with man not her husband Wicked	Nothing natural, everything strange; husband not husband; she not Mrs. H., does not know who she is, doctor and hospital not doctor and hospital, nurses are paper girls; "I thought we had a real war"	......

Severe Hypochondria	Mild Hypochondria	Anal-erotism	Auto-erotism	Irritability, Peevishness	Adult Sexuality	Poverty Ideas	Sleep	Varia
....	....	Occasionally soils when mentally deteriorated	......	Resistive with final deterioration	....	....	Sleep almost normal in spite of diurnal restlessness	Short episode of exophthalmic goiter
Examination of uterus caused mortification of spine; something snapped; body broken in two; rectum broken off; gone around the waist; will be blind; throat stopped up; nothing passes to stomach; can't be burned to ashes, would just roast	....	Rectum broken off; urine comes out wrong place	......	Whining, peevish	....	......	Often poor sleep	Loses flesh
....	Poor health	....	......	....	....	......	Poor sleep	
....	....	....	......	....	Brother-in-law at instigation of sister had made her pregnant Every forenoon says somebody had visited her at night Vaginal sensations			
....	....	....	......	....	Some one in room at night	......	......	Drops sexual ideas with greater anxiety
....	....	....	......	....	None			
....	....	....	......	....	Men come in at night; pregnant; vaginal sensations			
....	Malaise, pain, vomited; is given medicine to keep bowels from moving; somebody has spoiled her body	Food is offal (as a metaphor)	......	Disinclined to answer, "Please go away." More and more reticent, "said too much already." Wants to be left alone, pulls away petulantly when touched; irritability with striking and tearing things	Did not put curtain down when took bath. "If different men came every night, I did not know it." "It was shown to me that I practiced self-abuse"	No money to buy anything	Poor sleep at first only	Reported well four years after onset but could not forgive husband for taking her to hospital

TABLE 4.—CASES STUDIED—

Case No.	Age	Previous Attacks	Emotional State	Death Ideas	Other Apprehensive Ideas	Self-Accusation	Unreality	Negation
67	62	0	Uneasiness, fretful Restless, cannot sit down; intensely worried; voluble; cannot give data of life "because constantly thinking of wicked deeds done" More restless, temporarily quite intense; striking head against wall, crawling into fireplace, putting hand to throat as if to choke herself Restlessness marked, also marked curiosity, going around house looking into other people's rooms, reading their letters, etc.	Attempted suicide	....	Sin; is the evil one; spoke of remorse of conscience; niece and boarder did not get along, should have separated them, greatest crime in history, such wicked deeds. "When I was a child we played we were killing each other, then we acted angry and later I could not help doing the same and feeling the same, and now it has gone on until it has come to this." Not insane, has killed many people by pretending to be (predominant theme)	....	......

Severe Hypochondria	Mild Hypochondria	Anal-erotism	Auto-erotism	Irritability, Peevishness	Adult Sexuality	Poverty Ideas	Sleep	Varia
....	....	Constant putting of fingers in rectum and smearing feces; asked why did so, "Must have something to do"	......	....	....	Her clothes all stolen	Poor sleep	

38

SPINAL SUBARACHNOID BLOCK AS DETERMINED BY COMBINED CISTERN AND LUMBAR PUNCTURE

WITH SPECIAL REFERENCE TO THE EARLY DIAGNOSIS OF CORD TUMOR

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For some years the spinal fluid with the so-called Froin syndrome has been considered almost pathognomonic of compression of the spinal cord. This opinion has recently been reiterated by Leschke[1] and by Lantuéjoul,[2] each of whom collected a series of cases, the one chiefly from German sources, the other from the French. The practical value of the recognition of this fact is, however, almost nil because such fluids are usually found only after destruction of the cord, too late for operation or other therapeutic procedure.

For a much shorter time—about a decade—has it been known that a spinal fluid apparently normal in every respect except for protein increase is frequently to be found below a cord tumor. But fluid presenting isolated protein increase could hardly be considered more than suggestive of compression of the cord because a similar picture could be otherwise obtained. Nevertheless, in cases presenting the clinical picture of cord tumor a fluid containing marked increase in protein, and not otherwise abnormal, is a valuable correlative aid in diagnosis because it speaks for a degree of compression which is not necessarily destructive. If we could only be sure that such a fluid indicated tumor in a given case, it would be a valuable sign. Such evidence is furnished by a method published by me last year,[3] by means of which it is possible to demonstrate not only that the lumbar fluid is pathologic, but that the fluid above the tumor is different, and, most important of all, that an obstruction exists between the two.

At the time of writing the previous paper only nine patients had been examined by the combined cistern-lumbar technic; it is now possible to report on seventy-one such examinations in sixty-five patients.

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[1] Leschke: Ueber die Gelbfarbung (Xanthochromie) der Zerebrospinalflussigkeit, Deutsch. med. Wchnschr. April 7, 1921, p. 376.

[2] Lantuéjoul: La Coagulation Massive et Spontanée du Liquide Cephalo-Rachidien, Rev. Neurol. **36**:339 (April) 1920.

[3] Ayer, James B.: Puncture of the Cisterna Magna, Arch. Neurol. & Psychiat. **4**:529 (Nov.) 1920.

METHOD

The method is simple and easy to comprehend, but must be carried out with care. It must not be forgotten that while cistern puncture is easy it is potentially dangerous, and is absolutely contraindicated in certain cases of increased intracranial pressure.

The patient is placed on one side so that the points of puncture, cistern and lumbar, shall be on the same horizontal plane. A glass tube with water and an air-bubble to serve as a level has proved helpful in accomplishing this. After local injection with procain puncture of the lumbar sac and of the cisterna magna are made in turn (the technic of the latter is fully described in two papers previously published[4]) and each needle is fitted with a three-way stopcock, to the upright arm of which is attached a glass manometer. The fluids are then allowed to run into their respective manometers and readings made. Oscillations with pulse and respiration and changes of pressure on coughing and deep breathing are noted in each tube, but especially important is the increase in pressure on sudden accession of cerebral venous pressure. This may be easily produced by gentle pressure on both jugular veins in the neck. There is reason to believe that all of these oscillatory phenomena and pressure changes are normally equal in the two manometers. The stopcock of the lumbar needle is now opened and fluid released into a graduate, noting whether or not the cistern fluid falls during the procedure, and the same is repeated for the cistern needle noting the pressure in the lumbar manometer. The pressure in either manometer should fall promptly, usually 30 to 40 mm. following release of 5 c.c. of fluid from the other needle. After enough fluid from each locus has been withdrawn for examination it is well to repeat the observations on pulse oscillations and the effect of jugular compression. The needles are then withdrawn. The whole procedure should be accomplished in about fifteen minutes, with no more inconvenience to the patient than the discomfort of two punctures and the retention of a somewhat strained position for the length of time required.

The fluids are examined in the usual manner for cells, Wassermann and colloidal gold reactions, but especially for total protein, for which a quantitative method is desirable.[5]

In order to insure comparable readings in the two loci, it is necessary that each set of needles, stopcocks and manometer tubes be alike. The bore of the latter should be about 1.5 mm. to give the best visible oscillations and needles of 18 gage have proved most satisfactory. It is essential that the punctures be cleanly made, as blood-tinged fluids will vitiate both manometric and protein readings.

NORMAL FINDINGS

As we were not justified in performing combined punctures on normal persons, and as the method is obviously applicable only to the living, we have been forced to draw our conclusions as to normal from a variety of evidence. For example, a number of patients under treatment for optic atrophy and general paresis by means of serum administered by the cisterna magna route have afforded opportunity for double puncture; also numerous patients have been investigated by this method who were thought to have degenerative cord lesions, but in whom the possibility of cord tumor was raised, and a few of these patients having normal fluids have been examined surgically with negative findings, and one has come to necropsy, in whom no block had been demonstrated. Most convincing of all were the findings in two patients examined before and after removal of cord tumors, in whom the preoperative and postoperative findings were fundamentally different. A consideration of all of these leads us to conclude that normally the spinal subarachnoid space permits free passage of fluid in either direction, and that the composition of cistern and lumbar fluids is almost identical.

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[4] Wegeforth, Ayer and Essick: The Method of Obtaining Cerebrospinal Fluid by Puncture of the Cisterna Magna (Cistern Puncture) Am. J. M. Sc. **157**:789, 1919. Also footnote 3.

[5] Denis and Ayer: A Method for the Quantitative Determination of Protein in Cerebrospinal Fluid, Arch. Int. Med. **26**:436 (Oct.) 1920.

If we are correct in our assumption that normally the spinal subarachnoid space affords perfectly free communication to fluid, it is obvious that with two manometers, one at each end, we may demonstrate this continuity by lowering or by raising pressure at either end and reading the effect in the manometers. Various means for changing the pressure have been employed: Withdrawal of fluid and deep inspiration lower pressure; coughing, crying, grunting and injection of fluid raise it. Compression of both jugular veins, leading as it must, to increased cerebral venous pressure, has been found a reliable method of raising pressure and withdrawal of fluid the most satisfactory method of reducing it. Moreover, in using these two means there is no danger from the possible introduction of harmful substances into the meninges. All of these changes appear promptly and to an equal degree in both manometers in cases in which we believe the subarachnoid space is unobstructed. One more observation has been found to be of value in the manometric study of the spinal fluid; the pulse oscillations should normally appear in both manometers, but in cases apparently normal it frequently occurs that the oscillations in the cisternal manometer are greater in amplitude than in the lumbar, suggesting the cerebral rather than the spinal arteries as the source of both.

It will be seen that all of these observations constitute in reality a dynamic study of the fluid circulation within the spinal subarachnoid space. The demonstration of continuity or obstruction by these hydrodynamic tests forms the most reliable criterion on which we base our judgment of spinal subarachnoid continuity or of block.

Combined cistern and lumbar puncture affords us also an opportunity to examine both fluids in the laboratory. We know what normal fluid from the lumbar sac should be, and in this series are a number of cases in which all tests—chemical, cytologic and biologic—are almost identical in the two loci, and coincide with our idea of normal. We must believe that normally the two fluids are nearly the same, although a slightly greater protein content in the lumbar fluid appears to be constant. While the two fluids are frequently similar, a slight or a moderately greater protein reaction is obtained in fluid from the lumbar needle. The exact amount of normal difference in protein content of the two fluids is as yet debatable, and as it is the protein alone that has been repeatedly shown to be increased below cord tumors, this normal limit is of the utmost importance.

In that protein increase below obstruction has been repeatedly shown by numerous observers to be of transudative origin, we may consider these tests as primarily designed to show stasis.

It is, therefore, reasonable to conclude that under normal conditions hydrodynamic tests show the spinal subarachnoid space to be freely open, and examination of the fluids from the lumbar sac and cisterna magna shows them to be similar in character.

The findings in this series of sixty-five cases may be grouped as follows:

1. Those which we regard as normal. These have just been considered.
2. Those showing subarachnoid block, as demonstrated by hydrodynamic study, and also by increase of protein below the block (hydrostasis).
3. Those showing no block by dynamic tests but with well-marked difference in protein in the upper and lower fluids.

This paper deals especially with the second group in which evidence of block is clearly demonstrable.

CASES PRESENTING HYDRODYNAMIC AND HYDROSTATIC EVIDENCE OF BLOCK

In eighteen of the sixty-five patients examined by this method block was demonstrated according to both criteria. In all except one a satisfactory explanation was found, eleven by operation, three by the roentgen ray, two by a history of previous meningitis, and one by the effect of antisyphilitic therapy. Table 1 gives the data of chief importance in this correlation, with regard to these eighteen patients. Points of interest are: (1) that the block was shown between the ages of 13 and 59 years; (2) that all levels of the spinal cord are represented in the table; (3) that block was demonstrable whether caused by intramedullary, meningeal or extradural agents, in which (4) many pathologic types are represented. Of greatest importance is the fact that of the eighteen patients, nine showed clear, colorless fluids below the block as well as above it, abnormal fluids the significance of which might well have been overlooked on casual examination.

TABLE 1.—Patients in Whom Block was Demonstrated Both By Hydrodynamic and Hydrostatic Tests

Name	Age	Duration of Symptoms of Cord Compression	Appearance of Fluid		Pathologic Findings			Determined by	Remarks
			Cistern	Lumbar	Level	Location	Agent		
Mr. C.	38 years	6 months	Colorless	Colorless	Thoracic	Intramedullary	Gumma	Operation	Case 2
Mrs. C.	33 years	15 months	Colorless	Faint yellow, no clot	Thoracic	Intramedullary	Glioma	Operation	
Mr. F.	37 years	2 weeks	Colorless	Deep yellow, no clot	Lumbar	Extradural	Dislocated vertebra	Operation	Illustration 1920 report†
Mr. G.	24 years	4 months	Colorless	Faint yellow, no clot	Thoracic	Meningeal	Cholesteatomatous cyst	Operation	Case 3, 1920 report†
Mr. H.	41 years	7 years	Colorless	Lemon, no clot	Cervical	Meningeal	Chronic syphilitic meningitis	Operation	
Miss B.	13 years	10 weeks	*	Lemon, no clot	Cervical	Intramedullary	Glioma	Operation	
Mr. R.	13 years	3 weeks	Colorless	Colorless	Cervical	Extradural	Enchondroma	Operation	Case 4
Mr. S.	30 years	3 months	Colorless	Colorless	Thoracic	Extradural	Tuberculosis of spine	Operation	
Dr. A.	43 years	5 months	Colorless	Colorless	Thoracic	Extradural	Perineurial fibroma	Operation	Case 1
Mr. D.	42 years	18 months	Colorless	Colorless	Cervical	Intradural	Perineurial fibroma	Operation	
Mrs. J.	59 years	3 years	Colorless	Lemon, no clot	Thoracic	Extradural	Chondrosarcoma of spine	Operation	
Mr. S.	28 years	6 weeks	Pus (staph. aur.)	Yellow, clot, (sterile)	Thoracic	Meningeal	Adhesions	Clinical course	
Mr. O.	40 years	Indefinite	Colorless	Lemon, no clot	Diffuse	Meningeal	Syphilitic meningitis	Clinical course	Case 3
Baby S.	2 years	1 week	Colorless	Yellow, pus	?	Meningeal	Adhesions	Clinical course	
Mr. L.	38 years	1 year	Colorless	Colorless	Thoracic	Extradural	Dislocated vertebra	Roentgen ray	
Mr. S.	32 years	2 weeks	Colorless	Colorless	Thoracic	Extradural	Tuberculosis of spine	Roentgen ray	
Mrs. M.	35 years	Few months	Colorless	Colorless	Thoracic	Extradural	Tuberculosis of spine	Roentgen ray	
Mr. P.	68 years	Months	Colorless	Colorless	?	No abnormality found at operation			

* No fluid obtained from cistern puncture, as tumor filled this area.

† Reference to previous article in Arch. Neurol. & Psychiat. **4**: 529, 1920.

The pathologic findings may best be demonstrated by a consideration of four cases, chosen because of the striking manner in which the significance of the test was brought home to the examiner.

REPORT OF CASES

CASE 1.—*History.*—Mr. A., 43 years of age, had progressive paraplegia for five months. Recently there had been some numbness of the lower extremities, with an indefinite level of hypesthesia below the eighth thoracic segment and slight indication of a zone of hyperesthesia above. The gait was moderately spastic-ataxic. The blood and spinal fluid examined a short time previously had been reported "negative, with the exception of a positive globulin reaction" in the latter. In spite of the tests, syphilis was suspected, and the writer was asked to administer antisyphilitic treatment. This was not done because of the result of combined puncture the results of which are shown in Table 2.

TABLE 2.—RESULTS OF COMBINED CISTERN AND LUMBAR PUNCTURE IN CASE 1

	Cistern	Lumbar
Initial pressure	190 mm. (Same level)	150 mm.
After withdrawal of 5 c.c. from lumbar	180 mm.	60 mm.
After withdrawal of 5 c.c. from cistern	160 mm.	60 mm.
After withdrawal of 5 c.c. more from lumbar	165 mm.	0 mm.
After withdrawal of 5 c.c. more from cistern	145 mm.	0 mm.
Pulse oscillations	Just visible	Just visible
Respiratory oscillations	5 mm.	30 mm.
Rise of pressure on compression of jugular veins	300 mm.	No change
Character of fluid	Clear, colorless, no clot	Clear, colorless, no clot
Cells per cubic millimeter	0	2
Total protein per 100 c.c.	33 mg.	267 mg.
Globulin (ammonium sulphate)	0	+
Colloidal gold test	0000000000	0011100000
Wassermann reaction	Negative	Negative

Comment.—These tests indicate an unquestioned spinal subarachnoid block. If syphilis were the cause, it should in most cases be meningitic in type and the fluid should have shown cells and a positive Wassermann reaction. (Note Case 2 as a proved exception.) In a moderately progressive paraplegia with a sensory level developing, operation was clearly indicated. At operation (by Dr. W. J. Mixter) a large extradural perineurial neurofibroma was removed. The patient began to recover from the paralysis within two weeks, and is gaining rapidly at the present time.[6]

CASE 2.—*History.*—Mr. C., aged 38 years, had been treated by the writer for three years for spastic paraplegia due to unquestioned syphilis; blood and spinal fluid tests, formerly positive for syphilis, had become negative in every respect except for a slightly positive globulin reaction. For six months past he had become more spastic and complained now of numbness to the waist. The findings were marked paraplegia with sensory diminution below the tenth thoracic segment. The results of combined puncture are shown in Table 3.

Comment.—These hydrodynamic tests are not so convincing in description as on observation. A slight obstruction in the lumbar needle could cause the changes found, especially the slow rise and fall in the lumbar needle following compression of the jugular veins, but this test was repeated both before and after withdrawal of fluid with the same result each time. It seemed that with the change in symptomatology there might also be a change in pathology. Operation was therefore performed by Dr. Mixter and a well-marked diffuse swelling of the spinal cord was found, which on microscopic section of an excised piece showed typical gumma. It is probable that the formation of gumma was coincident with the increase in symptoms of cord compression, and it is important to note that it developed in a patient in whom Wassermann tests had become negative; also that neither before nor after the operation did the latter symptoms yield to antisyphilitic treatment.

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[6] Combined puncture has recently been repeated and now shows no block.

Case 3.—*History.*—Mr. O., 40 years of age, presented symptoms suggestive of root pain in the right thorax, intermittent for the past five years. There were no constant symptoms or signs of cord compression. A xanthochromic lumbar fluid giving a positive Wassermann reaction had been obtained. In this case it was thought possible that a syphilitic meningeal block was present, and therefore it was decided to determine whether this could be demonstrated by differential puncture. The findings from puncture of three loci of the subarachnoid space are given, the needles being introduced into a cistern, into the twelfth thoracic and fourth lumbar spaces, respectively. The readings following withdrawal of fluid are not satisfactorily recorded but indicated block. The effect of jugular compression was most instructive; a prompt rise was shown in the cistern manometer; after the pressure had risen about 100 cm. the fluid began to rise in the thoracic manometer, and later still in the lumbar. The fall in pressure on release of the jugular veins was in the same order, prompt in the cistern, slow in the thoracic and slower still in the lumbar manometers. A striking difference is also to be seen in the examination of the three fluids.

TABLE 3.—Results of Combined Puncture in Case 2

	Cistern	Lumbar
Initial pressure	90 mm. (Same level)	80 mm.
After withdrawal of 10 c.c. from lumbar	90 mm.	50 mm.
After withdrawal of 5 c.c. from cistern	60 mm.	50 mm.
Oscillations in manometer, pulse	Good	Almost none
Oscillations in manometer, respiration	Good	Slight
Increase of pressure on jugular compression	100 cm. prompt rise	100 cm. slow rise
Fall of pressure on jugular compression	Prompt fall	Slow fall
Character of fluid	Clear, colorless, no clot	Clear, colorless, no clot
Cells per cubic millimeter	28	8
Total protein per 100 c.c.	68 mg.	178 mg.
Globulin	+	++
Wassermann reaction	Negative	Negative
(Blood Wassermann reaction negative)		

TABLE 4.—Results of Combined Puncture in Case 3.

	Cistern	Thoracic 12	Lumbar 4
Character	Clear, colorless no clot	Light yellow, no clot	Darker yellow, no clot
Cells	6	24	—
Total protein per 100 c.c.	42 mg.	869 mg.	952 mg.
Globulin	0	++	++
Colloidal gold test	0000000000	0000012100	000012200
Wassermann test	+++	+++	+++

Comment.—The examination apparently demonstrated by physical and chemical procedures that the subarachnoid space is here separated into compartments, not freely intercommunicating, and appears to corroborate the diagnosis of a diffuse syphilitic meningitis. Under antisyphilitic treatment the patient rapidly improved and two months later combined puncture (cistern and fourth lumbar space) gave a very different picture.

Comment.—This examination in no way resembles that before treatment. It is reasonable to think that under treatment the obstruction to the free passage of fluid in the spinal meninges has been removed.

Another combined puncture has recently been repeated in the case of this patient, the findings being essentially as last recorded, namely, no block was demonstrated. During the interval—about six months—the patient has been clinically well.

TABLE 5.—Results of Puncture in Case 3 After Antisyphilitic Treatment

	Cistern	Lumbar 4
Initial pressure	185 mm. (Same level)	135 mm.
After withdrawal of 5 c.c. from lumbar	140 mm.	100 mm.
After withdrawal of 5 c.c. from cistern	115 mm.	75 mm.
Oscillations with pulse	Good	Fair
Increase on jugular compression	Prompt rise and fall	Prompt rise and fall
Character of fluid	Clear, colorless	Clear, colorless
Cells	4	8
Total protein	27 mg.	67 mg.
Globulin	0	0
Sugar	0.046 per cent.	0.046 per cent.
Wassermann test	....	Weakly positive

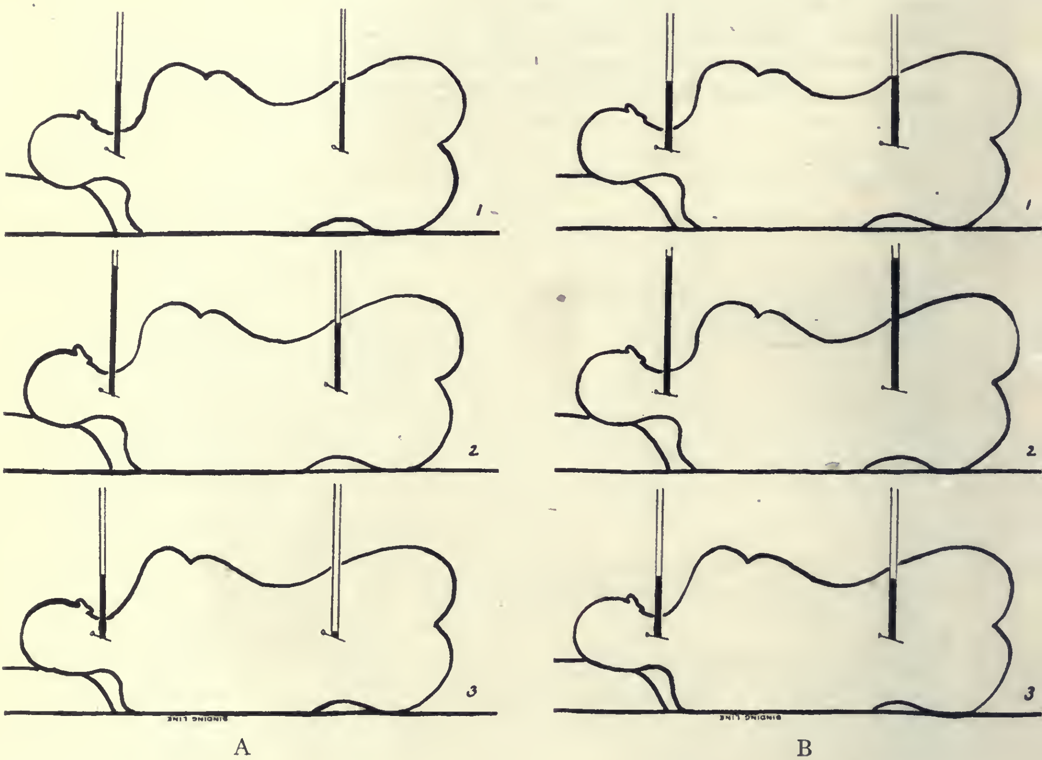
TABLE 6.—Results of Combined Puncture in Case 4

Sept. 21, 1920	Cistern	Lumbar
Initial pressure	130 mm. (Same level)	140 mm.
After withdrawal of 6 c.c. from lumbar	130 mm.	0 mm.
After withdrawal of 10 c.c. from cistern	50 mm.	0 mm.
After injection of 9 c.c. of saline into lumbar sac	100 mm.	180 mm.
Pulse oscillations	Good	Slight
Change of pressure on jugular compression	Prompt rise to 200 mm.	No rise
Character of fluid	Clear, colorless no clot	Clear, colorless, no clot
Cells	3	1
Protein (alcohol precipitation)	Normal	Marked increase

The following case is perhaps the most instructive, because operation for spinal cord tumor would not have been undertaken at the early date on which it was performed but for the demonstration of subarachnoid block.

Case 4.—*History.*—R., 13 years of age, presented an apparently typical right hemiparesis, involving the face, arm and leg, but he had also a slight deltoid atrophy. There was no objective sensory disturbance at this time or subsequently. Shortly afterward spasticity appeared in the left leg also, and for this reason the possibility of cord tumor was considered and combined puncture performed.

The examination indicated subarachnoid block, but as the method was at that time new, and there was so little guide as to the location of the block, the patient was observed for two weeks, during which time slight spasticity began in the left arm. At this time (October 8) combined puncture was repeated, with the same findings as before. On this second examination total protein quan-



A, diagrammatic representation of some of the findings in Case 4, showing spinal subarachnoid block. 1, initial pressures, on same level; 2, effect of jugular compression. Pressure rises promptly in cistern, not at all in lumbar manometer. 3, effect of withdrawal of 6 c.c. of spinal fluid from lumbar sac. Pressure here falls to zero; pressure in cisterna magna unaffected. The lumbar fluid contains an excess of protein; that from the cistern is normal.

B, same case as in A. Tests repeated two months after removal of extradural tumor. 1, initial pressures; 2, effect of jugular compression; 3, result of withdrawal of 5 c.c. of fluid from lumbar sac. The fluids in both manometers now maintain the same level under all conditions. The two fluids are now similar in character.

titation showed 21 mg. per 100 c.c. in cistern fluid, 85 mg. in the lumbar. Operation was now undertaken (Dr. C. A. Porter), our chief guide as to level being the deltoid atrophy. An enchondroma, originating from the intervertebral disk, presumably of the fifth cervical vertebra, was found deeply indenting the dura mater and the underlying cord.

Following the removal of this tumor the patient rapidly regained his power. On December 15 another combined puncture was performed, the results of which are shown in Table 7.

Comment.—The postoperative findings coincide in every detail with our conception of normal relations of cistern and lumbar fluids. The examinations in this case are invaluable in determining what is normal and what is pathologic, and consequently what criteria are to be relied on in our estimation of subarachnoid block. In this case, moreover, it is not too much to say that we had at hand a diagnosis of block before a diagnosis could be made from clinical examination and that when operation was performed one of the most important clinical signs—a level of sensory change—was still entirely absent. It is well also to emphasize the unusually rapid improvement following operation, due as much to the early diagnosis as to the operative skill.

TABLE 7.—Results of Postoperative Combined Puncture in Case 4

	Cistern	Lumbar
Initial pressure	190 mm. (Same level)	160 mm.
After withdrawal of 5 c.c. from lumbar	160 mm.	130 mm.
After withdrawal of 5 c.c. from cistern	130 mm.	95 mm.
Oscillation with pulse	Good	Fair
Change of pressure on jugular compression	Prompt rise and fall	Prompt rise and fall
Character of fluid	Clear, colorless no clot	Clear, colorless, no clot
Cells	0	0
Total protein per 100 c.c.	29 mg.	33 mg.
Globulin	0	0

The findings in this case are as convincing as a well-conducted physiologic experiment. We find a fluid which definitely demonstrates a block. At operation the dura and its contents are found "knuckled" and displaced; this is relieved without opening the subarachnoid space, and two months later we find a free passage and entirely normal fluids above and below.

EVIDENCE OF STASIS ALONE

Two patients showed no evidence of obstruction to the free passage of spinal fluid in the subarachnoid space, and yet marked difference in protein was found in cistern and lumbar fluids; in fact, the difference was more marked than in some cases in which an hydrodynamic block was observed. One of these patients presented a vertebral myeloma at operation (cistern 100 mg., lumbar 250 mg. of protein); the other subdural neurofibroma at necropsy (antemortem fluids, cistern 30 mg., lumbar 135 mg.). The question arises, How much reliance shall be placed on the findings of excess protein alone in the lumbar sac? Can we say that excess in the lumbar fluid twice that of the cistern, or thrice or four times indicates cord compression? We are obviously on much less certain ground in our reasoning in the absence of a block dynamically shown to be present.

In order to make any statement on this point it will be necessary to know to what extent conditions other than cord compression can alter the normal chemical findings in the fluids drawn from above and below, and this will require more data than are at present available. In this series of seventy-one punctures the lumbar protein estimation has been found to be twice that of the cistern fluid in several cases of multiple sclerosis and in one case of undoubted acute poliomyelitis. In no case has a difference of more than this been noted in patients presenting an uncomplicated degenerative or exudative myelitis. This whole subject of variation in the character of the spinal fluid associated with nonobstructive lesions is intensely interesting and important, but one which will require much further study.

CASES PRESENTING NO EVIDENCE OF HYDRODYNAMIC BLOCK OR STASIS

We have already considered this group and come to the conclusion that absence of block as demonstrated by the foregoing procedures is the normal state. The important question now arises, Can we have cord compression with fluid findings normal in every respect? Certainly we can. This was proved in one case of this series. The patient was a man who had been paraplegic for ten years, with a well-defined sensory level of anesthesia. The tests were normal in every way, the two fluids being identical on examination. At operation an elongated epidural multilocular cyst was found. In a considerable number of cases examined as to lumbar fluid alone normal protein values have been obtained in a few; as protein excess seems to antedate demonstrable block, it is likely that combined puncture would in these patients have showed normal dynamic relations. It is interesting to note that operation in these cases has in the experience of the writer never been of value in restoration of function.

SUMMARY AND CONCLUSIONS

For some years valuable data as to the presence of spinal cord compression have been obtained from examination of the lumbar fluid. The actual value of these tests was, however, often only confirmatory, and at times purely academic, for by the time a fluid could be called pathognomonic or even strongly suggestive of cord tumor myelitic changes were usually so marked as to negative the effect of an otherwise successful operation.

By means of double punctures certain writers of the French school have obtained information of value, but their method of approach, that is, puncture of thoracic spine, etc.,[7] is hardly applicable to systematic study of doubtful cases; nor do these writers appear to have laid sufficient stress on the importance of pressure changes under different conditions, relying chiefly on the less important laboratory examination of the fluids obtained.

By the use of combined cistern and lumbar puncture it is possible not only to obtain fluid above and below a supposed cord lesion, but also to analyze the mechanical factors involved in the flow of the fluid, and thereby estimate the permeability of the subarachnoid space. Where obstruction has been demonstrated by this means, an adequate explanation has been found in seventeen of eighteen cases. The importance of the procedure lies in the fact that definite evidence of pathology is forced on the investigator early in the process of compression, and that if advantage is promptly taken of the findings a relatively intact cord may be saved. Hence this method may show obstruction in patients in whom compression seems unlikely, whereas the chemical findings from lumbar puncture alone are usually not sufficiently striking until a diagnosis of cord compression is clinically apparent.

It is not to be thought that every cord tumor will present the picture of subarachnoid block, but it is clearly shown that cord tumor frequently presents a block very early. Hence the positive findings are of great value. Negative findings are of relative importance.

In that cistern puncture requires considerable practice and is a potentially dangerous procedure, it is fortunate that certain hydrodynamic studies of value may be carried out on the lumbar fluid alone. Most significant of these is the observation of the pulse oscillations and change of pressure on artificially increasing cerebral pressure by compression of the jugular veins. These observations call for a return to the use of the original aqueous manometer, which in the writer's opinion should be employed in every diagnostic lumbar puncture.

Note.—Not until this paper was finished was my attention called to a paper by Queckenstedt[8] in which he writes of the significance of jugular compression in spinal cord tumor. His conclusions are amply confirmed by my observations. It is, however, obvious that by the use of the combined puncture slight changes in dynamic tests and slight differences in chemical composition of the two fluids must be of greater significance than abnormalities in the lumbar fluid alone.

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[7] Marie, Foix and Bouttier: Double punction sur-et-sous-lesionelle dans un cas de compression medullaire: xanthochromie, coagulation massive dans le liquide inferieure seulement, Rev. Neurol., 1914, p. 315; Ravaut and Krolunitsky: Oreillons et meningite cerebro-spinale a paramenigo-cocques. Guerison par injections intrarachidiennes lombaires et cervicales, Soc. méd. des hôp. de Paris **39**:618, 1915. Souques and Lantuéjoul: Hyperalbuminose enorme du liquide cephalo-rachidien dans un cas de coagulation massive, Rev. Neurol., 1920, p. 137. Marie, Foix and Robert: Service que peut rendre la punction rachidienne pratiquée a des etages differents pour le diagnostic de la hauteur d'une compression medullaire, Rev. Neurol., 1913, p. 712.

[8] Queckenstedt: Ztschr. f. Nervenheilk, **55**:325, 1916.

DISCUSSION

Dr. Henry Viets of Boston stated that before the war he had the pleasure of working with Dr. Ayer in some of his early work on spinal fluid, although he played a very minor rôle in that work. Since then he had watched with the greatest interest Dr. Ayer's subsequent studies. He believed that Dr. Ayer, in his work on cistern puncture and subarachnoid block, had made a most valuable contribution to neurology, especially helpful in the diagnosis of spinal cord tumors and in the treatment of syphilis of the nervous system, and meningitis.

Dr. Viets stated that he had found some doubt in the minds of men throughout the country regarding the advisability of cistern puncture because of its well-known dangers. He felt, however, that in experienced hands, there was little danger in this operation and that one was always surprised, after one or two punctures had been made, at the ease with which this procedure could be carried out.

The value of cistern puncture was emphasized in a recent case of meningitis in which numerous spinal punctures had failed to obtain fluid and there was an obvious condition of subarachnoid block from meningitis. As the patient rapidly became worse, a cistern puncture was performed with the release of a large amount of purulent fluid, and antimeningitis treatment was given in the cistern at the same time. The man made a rapid recovery after this procedure.

Dr. Charles A. Elsberg of New York said that he had had no experience with cistern puncture; in fact, he stated that he had been rather afraid of it. If left in the hands of one as expert as Dr. Ayer to work out the method, it might be developed into a relatively safe procedure, and then it might be useful in certain classes of cases.

In answer to a question by Dr. Schwab regarding the possible surgical objections to this method, Dr. Elsberg said that Dr. Ayer could answer the question better than he. Dr. Elsberg's objection, which was theoretical and perhaps entirely wrong, was that the degree of distention of the cisterna varied according to the patient and condition. In suboccipital operations he had often seen the cisterna magna distended with fluid so that it probably could be punctured with safety, but in many instances, the cisterna was small—not more than 2 cm. wide and from 0.25 to 0.5 cm. in depth. In such a small cistern, he had wondered how great the danger of cistern puncture would be.

Dr. Ernest Sachs of St. Louis said he had been very much impressed with the careful work that Dr. Ayer had done in this direction and unquestionably the procedure seemed very safe in his hands. Dr. Sachs said he had always been impressed with the fact that whenever he exposed the medulla there was marked movement of the medulla with each respiration. It was his belief that the basal cisterna was there so that the medulla would have ample room to move back and forth with each respiration. It seemed to him that this might be a possible source of danger.

Dr. Sachs asked whether Dr. Ayer's procedure would positively prove in which cases there was a block to the cerebral spinal circulation; if this were possible, the cases of so-called myelitis which had no block would not need exploratory operations, and this would be of inestimable value to patients.

In last year's meeting of the American Neurological Association he brought up a point which seemed to Dr. Sachs a real danger. He pointed out that the circular vein which runs around the foramen magnum might be punctured as it sometimes extended below the foramen magnum. Dr. Cushing attacked him rather violently and said this vein never extended below the foramen magnum.

Dr. Sachs had one case in the past year of a child with a cerebellar tumor, in which this circular vein was enormously enlarged and extended up about a centimeter above the foramen magnum and also below, and he was quite sure that in this particular case had a puncture been done, the sinus (it was a sinus; it was no longer a vein) would unquestionably have been hit with the needle.

Dr. Simon P. Kramer of Cincinnati said that Dr. Ayer's work on puncture in the cistern had again proved that lumbar anesthesia should be abandoned, and that there should be no intraspinal medication with anything in the nature of a neural poison.

So far as the danger of cistern puncture was concerned, he agreed with Dr. Ayer, that there was no more danger from subarachnoid punctures than from those in the lumbar region. The same danger, of course, existed there. Dr. Ayer had spoken of the fact that puncture should not be performed when one suspected an intracranial tumor. In all other cases the procedure was just as safe as a puncture of the subarachnoid space in any other part of its course.

Dr. Charles Elsberg of New York, apropos of Dr. Kramer's remarks, asked whether Dr. Kramer meant to say that a puncture in the lumbar region below the lower end of the cord and between nerve roots was no less dangerous than a puncture anywhere along the spinal canal where there was cord, and especially high up where the medulla was situated. He asked whether Dr. Kramer meant that there was no more danger when the medulla lay in front of the needle than when there were only nerve roots.

Dr. Henry A. Cotton of Trenton, N. J., stated that during the past year over 200 cisterna punctures had been performed in the State Hospital at Trenton without any ill effects. They had substituted it temporarily for the intracranial treatment in paresis, and so far as he had been able to see there was less reaction from a cistern puncture than from a lumbar puncture; the patients really preferred it. Those who were intelligent asked for a "neck puncture" as they called it, rather than a lumbar puncture. It is a valuable method, and in time it will be a great improvement over the lumbar method of treatment. The method can be used with safety, but like all technic must be done correctly. There was no danger whatever, as far as he was able to judge, from the 200 punctures which had been performed.

Dr. James B. Ayer of Boston, in closing, said that he realized that the question of safety in carrying out cistern puncture was of paramount importance. Unquestionably the procedure was potentially dangerous, but if a person familiar with lumbar puncture proceeded cautiously, with due attention to detail of needle, position of patient, etc., he believed it safe. Even if the median vein of which Dr. Sachs spoke were present, he questioned whether a blunt needle would perforate it. As a matter of fact about 500 cistern punctures had been performed by a number of workers so far without serious trouble, and it is now being employed at the Massachusetts General Hospital more and more frequently, not as a substitute for lumbar puncture, but where indicated, usually in spinal subarachnoid block.

Concerning the movement of the medulla spoken of by Dr. Sachs, he said that before the method had been used on the living, several cadavers had been examined. Needles were placed in the cisterna and brain removed above the pons; in these subjects it was possible to flex, extend and rotate the head without causing the medulla to jam backward and impinge the needle. It would be expected that in some cases of brain tumor the relations might be such that the medulla might obliterate the cisterna magna; these cases should be studiously avoided.

As for the suggestion that because cistern-lumbar puncture does not render positive findings in every case of cord tumor it is therefore worthless, it seemed to him no argument at all. That it usually gave information of value very early should outweigh the fact that it sometimes failed.

In concluding, Dr. Ayer emphasized his change of attitude toward cord tumor cases in view of the findings of subarachnoid block. Previously, in his experience, operation was seldom undertaken unless a diagnosis was almost certain. Now the presence of subarachnoid block was forced on the examiner, at times long before a diagnosis of cord tumor could be more than just entertained as a possibility. By using this method the necessity for operation has been forced on the mind much earlier, and in a number of patients the prognosis has accordingly been much brighter.

ACUTE BENIGN MENINGO-ENCEPHALITIS WITH PAPILLEDEMA

FOSTER KENNEDY, M.D.
NEW YORK

The following cases are grouped because they have many factors in common, together making a picture which, as far as I can discover, has not been made plain in the literature on inflammations of either the meninges or brain substance. None of them has the general coloring which we have learned to associate with epidemic encephalitis, but the fact that they have come to notice during the period of incidence of that disease and were not familiar to us before that time is enough to make one cautious about asserting that the two conditions are entirely unrelated. My patients all had evidence of systemic infection, as shown by the presence of a changed blood picture, fever and general malaise. The onset was acute—in some cases sudden, with headache serving as an inadequate warning of trouble to come. In all, a period of stupor was followed by one of excitement or disorientation, which lasted only a few days in most instances, to be followed, as a separate episode, by focal cerebral palsy-hemiplegia, hemianopia, aphasia or cranial nerve inadequacy. The rushing onset of optic neuritis late in the illness, synchronizing with amelioration of symptoms previously acquired, and its rapid amelioration in turn, are phenomena with which I, at least, have been unacquainted, and must surely depend, for their production, on sudden blockings of intraventricular drainage by meningitic exudate, and for their disappearance, on a reconstitution of a normal fluid mechanism.

REPORT OF CASES

Case 1.—*History.*—L. C. P., aged 35, admitted to Bellevue Hospital on Feb. 2, 1921, had had headache for a week previously and a frequent twitching of the left side of the face. On Feb. 2, he left his partner when apparently otherwise in normal health, went into a subway train, became noisy and was therefore ejected from the train; became restless, yawned often and passed into unconsciousness. His tongue was coated, dry and lacerated, and the uvula was covered with a white membrane. His pharynx was congested and his neck was rigid. Kernig's sign was present. The pulse rate was 120, and his temperature was 104. The systolic blood pressure was 150. Spinal fluid: raised pressure, clear, 70 cells (98 per cent. lymphocytes). Globulin was increased, and the Wassermann test was negative. The colloidal gold test showed normal precipitance. The Wassermann test of the blood was negative; a blood culture was negative. There were 17,000 white blood cells per cubic millimeter of which 82 per cent. were polymorphonuclears. There was incontinence of urine and feces. He perspired profusely. There was punctate erythema over the back and buttocks which faded in a few days. The throat culture was that of *Staphylococcus* *aureus.* Blood chemistry examination revealed a slight nitrogen retention and, oddly enough, a low blood sugar content. The fundi were normal. The abdominal reflexes were absent. There was a Babinski sign on the left.

Course.—Two Days Later: The temperature was 100. He was no longer unconscious, but was entirely amnesic for the events of his illness. He was rational except for short periods at night. He had a severe headache and was drowsy, but he was no longer incontinent. On the preceding day he became conscious and was violent, requiring restraint.

Three Days Later: The rash was disappearing. His temperature was normal in the morning; 100 at night. He was drowsy, restless and had twitching of the limbs and fingers. He complained of sensitiveness over the left auricle and left side of the face. Examination of the ears was negative. He yawned frequently.

Two Days Later: His speech was not clear. There was evidence of anomia. He was fluent but incorrect in naming seen objects, and was embarrassed by his mistakes. He continued in perseveration of his errors to his own confusion.

Eighth Day of Illness: He was stuporous aud refused to talk. His head was retracted. Kernig's sign was more positive. Examination of the ear was negative. There was tenderness over the left temporoparietal area and auricle. The spinal fluid contained 81 cells (lymphocytes 92 per cent.); culture and guinea-pig inoculation were negative; no tubercle bacilli were found.

Ninth Day of Illness: The stupor had largely disappeared, and he was rational. He was well oriented but presented a complete picture of temporosphenoidal aphasia, together with a central weakness of the right side of the face. A radiogram of the skull at this date was negative for sinus disease or fracture.

Tenth Day: In the morning he had fluent anomia, weakness of the entire right side and hemianesthesia including the right cornea. There was ankle clonus on the right. There were 20,000 white blood cells of which 81 per cent. were polymorphonuclears. He was restless and tried to get out of bed. His temperature was never higher than 100 F. at night and was usually normal by day. The fundi were normal.

Twelfth Day: His condition was practically unchanged. The relative weakness of the right arm and leg had decreased, but drowsiness was great and the aphasia unchanged. The fundi were still normal.

Fourteenth Day: Hemianesthesia was less evident. Drowsiness was severe. Occasionally he named objects correctly. On the next day no sign of sensory defect could be made out. The aphasia was serious but it was improving. Drowsiness was less severe. The fundi were normal; owing to the obvious suspicion that he had a brain abscess, these were examined daily, despite daily improvement in the pyramidal abnormality and aphasia.

Eighteenth Day: On this day, when all sensory defect was gone, the right hemiplegia reduced to a weakness of the lower part of the right side of the face and absence of the right abdominal reflexes, and when the aphasia though still severe, was clearly improving, I was astonished to find the nerve heads distinctly hyperemic, the margins blurred and linear striate hemorrhages on the retinae. Within twenty-four hours there was a swelling on each nerve-head of 4 diopters which shortly afterward became 6; the veins became engorged and tortuous, and splashing hemorrhages were seen around the disk and on the papilla itself. From that time on there was a constant improvement in the focal signs and symptoms, but the fundal state did not change for four and a half weeks; then rapid improvement and absorption of hemorrhages began so that restitution of normal conditions in the eye as regards appearance and function was complete in ten days. The patient is now perfectly well, with the exception of some naming difficulty when fatigued.

Case 2.—*History.*—E. O., a pregnant woman aged 30, had lobar pneumonia on Jan. 23, 1921. Five days later labor began. Presentation was impossible and embryotomy was performed. On the eleventh day of the pneumonia the fever had disappeared, and the patient seemed to be having normal convalescence. On February 6, she complained of severe headache and tenderness over both mastoids; the temperature rose to 100 F., and the pulse rate fell to 50 from 80. The next morning she was stuporous and had a left hemiplegia; she was restless, almost violent, and noisy. Next morning she was in coma, the temperature was 103 F., the pulse rate 100, and slight blurring of the disks was thought indefinitely to be present on both sides, but especially on the left. On that day she had a dozen focal convulsions, beginning on the left side of the face, and at this end involving both sides equally. On the second day of hemiplegia the blood count was 12,000 white cells, of which 77 per cent. were polymorphonuclears. On the third day there were 23,800 white cells, of which 83 per cent. were polymorphonuclears.

The spinal fluid contained only 7 cells and was normal in all its reactions. Five days after its onset, the hemiplegia began to clear up, the leg recovering first. Consciousness returned slowly, and the patient could repeat a few words after her husband. The temperature was 101 F., however, and a few hours after regaining consciousness she developed visual hallucinations, and was violent and disoriented for five days, after which she was mentally clear and emotionally placid. During this stage the spinal fluid was normal, except that it was under pressure and had a mononuclear content of 12.

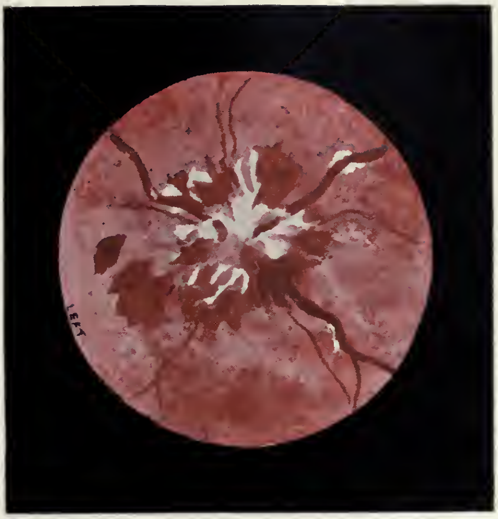
Course.—Twelve days after the onset of her hemiplegia, the temperature, pulse and respirations were normal. She had headache, especially over the right posterior parietal region, but the palsy had disappeared from the face and leg and was improving daily in the left arm. The optic disks were moderately blurred, the margins, however, being clearly seen, and no swelling capable of measurement was present. On the morning after this fundal observation, she complained of increased headache and of not being able to see properly. The right retina was then found to be the seat of several large hemorrhages, and on the left were smaller hemorrhages; these increased in size and number in both eyes for seven days. Edema was 6 diopters in height, and no disk margin was visible on either side. In this attack of optic neuritis there was no added symptom beyond increased headache. Vision on the third day was reduced to 20/60 and paracentral scotomas were present. On the seventh day after the appearance of retinal hemorrhage, the swelling of the papillae began to subside, the scotomas to decrease, the retinal blotches to contract and vision to return to normal. At the present time this patient is without symptoms, but the disk edges are not quite clear, though papilledema is negligible and vision normal.

Case 3.—*History.*—Mrs. R., aged 67, was seen by me in consultation with Dr. Lloyd of Brooklyn in November, 1919. Her illness began two weeks before my visit, with headache, moderate fever and intense pain in the back of the neck. After some days she had moderate ptosis of the left eyelid which rapidly became complete, and to which was added palsy of all ocular muscles served by the left third nerve. She had no lethargy—there were no symptoms referable to a periaqueductal lesion. Fever never rose higher than 101 F., and the temperature was normal after the third week. There was slight rigidity of the neck and a moderate Kernig's sign. The spinal fluid, in the third week of illness, contained 70 lymphocytes and was bacteriologically negative, and negative also to the Wassermann test. In this same week she began to complain of numbness and tingling in the right hand and to have a distinct naming difficulty, which in a week's time developed into an absolute temporosphenoidal aphasia of fluent type. She then became violently excited, screamed often and long, was disoriented and harbored constant vague persecutory delusions. The fundi were normal throughout her illness. The condition remained practically unchanged for three months, when rapid improvement occurred, so that in three weeks or less she made only occasional errors in speech, and there was only a slight ptosis of the left eyelid. This patient is now well, though upward movement of the left eye has not returned, and her speech is normal. No outspoken right pyramidal signs ever developed. The position of the lesion, which I presumed to be a localized meningitic exudate, must have been basal and must have included the left third nerve as it winds around the crus, and also the adjacent temporosphenoidal lobe. She complained throughout her illness of pain and tenderness in the left temple. A careful radiographic examination showed the sphenoidal and other sinuses to be free from disease. The localized bony tenderness here is to be compared to the left auricular and facial tenderness of the first case and the right posterior parietal tenderness of the second. Kidney function tests were normal as was the blood chemistry for nitrogen and sugar. A leukocytosis of 15,000, of which 65 per cent. were polymorphonuclears, obtained in the second week of her illness.

Case 4.—*History.*—A. B., a woman aged 46, complained in December, 1920, of insomnia, headache and a feeling of mental confusion. In January she became disoriented and noisy, and was admitted to the psychopathic department of Bellevue Hospital. Her blood pressure was: systolic 290, diastolic 70, but no renal defect could be discovered, though the fundal eye vessels were distinctly sclerotic. After a month her mental condition was again normal, but on March 3, she was stuporous with paresis of the left side, had half-sided pathologic reflexes and was incontinent of urine with some impairment of speech and orientation. There was acute tenderness over the right parietal area. The spinal fluid contained 29 cells per cubic millimeter and was culturally negative. The Wassermann test was negative in the blood and spinal fluid.

Course.—Three days later the fundi presented the appearance described in the other cases—profuse hemorrhages splashed on and around the disk which was itself acutely swollen. She was garrulous and unaware of her surroundings; she vomited and was incontinent. These symptoms lasted until March 21, and to them was added a complete left hemianopia. Amelioration of all abnormal conditions then began; inside a week she was clear mentally, felt and looked well, and the left hemiparesis and hemianopia had quite disappeared. The papilledema had almost disappeared, and the retinal hemorrhages were undergoing absorption. In May, 1921, she presented no signs or symptoms of her illness, though essential hyperpiesia was maintained as before her acute condition occurred.

Case 5.—*History.*—C. K., aged 20, in February, 1920, had severe left-sided headache for two days, after which she awoke in the night and found herself unable to move the right arm or leg. She became frightened, screamed loudly, became unconscious and remained so for two days and nights. On recovering consciousness she was excited, required restraint and was completely aphasic. These conditions, together with urinary incontinence, lasted for twelve days, after which she became rational again and the aphasia rapidly improved. She was admitted to the neurological department of Bellevue Hospital on March



Case 4.—These fundal phenomena developed inside twenty-four hours during the tenth week of illness. They persisted for only seventeen days and then began rapidly to improve so that the fundi again became normal. (Drawn by Dr. Fairbanks, Bellevue Hospital.)

Illustrating Article by Foster Kennedy, M.D.
Archives of Neurology and Psychiatry, January, 1922

8, 1920, for "nervousness and right hemiplegia." She had no trace of aphasia then; the hemiplegia was only relative in degree and most evident in the right leg. The fundi—normal on admission—were covered two days later with hemorrhages, and the papillae were invisible through swelling. On this day she had severe left parietal headache; she vomited and was restless and uneasy. Lumbar puncture showed a fluid under increased pressure, of a light yellow color, thicker than usual and containing 20 lymphocytes. Papilledema was at its height in three days from its inception; it then rapidly retrogressed and in ten days no swelling could be made out. In three weeks all trace of the hemorrhages had also disappeared. This patient today—fifteen months after her illness—is normal except for a spastic cerebral paresis of the right lower extremity.

CONCLUSION

One cannot view the rapidly fluctuating syndromes of these cases, of true epidemic encephalitis, or of acute disseminated sclerosis, without being impressed by the rôle played by edema in cerebral lesions, and the different prognosis produced by mere physiologic block on the one hand and by obliteration of structure on the other.

A MORE ACCURATE CLINICAL METHOD OF DIAGNOSIS OF PERIPHERAL NERVE LESIONS AND OF DETERMINING THE EARLY RECOVERY OF A DEGENERATED NERVE

WITH REPORT OF CASES AND EXPERIMENTAL DATA *

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Introduction.
Description of instrument by Professor Pyle.
Physiologic principles of muscle and nerve muscle reactions based on a consideration of the literature.
Clinical application of chronaxie.
Discussion of other methods.
Relation of induced waves of opening and closing.
Experimental data.
Clinical cases.
Discussion.
Summary and conclusions.

INTRODUCTION

Since surgeons and neurologists primarily have had to deal with the large number of peripheral nerve injuries resulting from the late war, there has been an unusual number of investigations carried on to determine the underlying principles of nerve regeneration and the best methods of treating them. The physiologic and anatomic features of nerve degeneration, as well as the surgical methods to correct them, have been studied particularly by Howell,[1] Huber,[2]

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* This paper was read in abstract before the American Neurological Society, June 14, 1921, Atlantic City.

[1] Howell and Huber: A Physiological, Histological and Clinical Study of the Degeneration and Regeneration in Peripheral Nerve Fibers After Severance of Their Connection with the Nerve Centers, J. Physiol. **13**:335, 1892; **14**:1, 1893.

[2] Huber, G. C.: A Study of the Operative Treatment for Loss of Nerve Substance in Peripheral Nerves, J. Morphol. **11**:630-733, 1895; Transplantation of Peripheral Nerves, Tr. Chicago Path. Soc. **11** (June 1) 1919; Repair of Peripheral Nerve Injuries, Surg., Gynec., & Obst. **30**:464 (May) 1920.

Ranson,[3] Vanlair,[4] Kilvington,[5] Sherren,[6] Lewis,[7] Langley,[8] Pollock,[9] Tinel,[10] Athanassio Bénisty [11] and others. Few of the researches have combined the physiologic and anatomic methods. The problem, however, on which little advance has been made is the determination of whether a paralyzed peripheral nerve has any regenerative power. To the surgeon this question is of vital importance, for, though we now know that secondary nerve sutures when carried out by the newer methods afford a much better prognosis than was formerly supposed, a nerve suture should be undertaken at the earliest possible moment. Therefore, if it were possible to determine earlier than heretofore that a paralyzed nerve is beginning to regenerate, a great advantage would be gained.

Keith Lucas [12] and Lapicque [13] demonstrated on cold blood animals that there were certain striking differences between muscles with intact

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3. Ranson, S. W.: Degeneration and Regeneration of Nerve Fibers, J. Comp. Neurol. **22**:487, 1912; Non-Medullated Nerve Figers in Spinal Nerves, Am. J. Anat. **12**:67, 1911.

4. Vanlair, C.: De la néurotization du cartilage osseux dans la suture tubulaire des nerfs, Arch. de physiol., norm. et path. **9-10**:595, 1882.

5. Kilvington, B.: An Investigation on the Regeneration of Nerves, Brit. M. J. **1**:935 (April) 1905. Osborne, W. A., and Kilvington, B.: Axon Bifurcation in Regenerated Nerves, J. Physiol. **37**:1, 1908. Kilvington, B.: An Investigation on the Regeneration of Nerves with Regard to Surgical Treatment of Certain Paralyses, Brit. M. J. **1**:1414, 1908.

6. Sherren, J.: Injuries of Nerves and Their Treatment, New York, William Wood & Co., 1908.

7. Kirk, E. G., and Lewis, D. D.: Regeneration in Peripheral Nerves, Bull. J. Hopkins Hosp. **28**:71 (Feb.) 1917; Fascial Tubulization in Repair of Nerve Defects, J. A. M. A. **65**:486-491 (Aug. 7) 1915.

8. Langley, J. N., and Anderson, H. K.: On Autogenetic Regeneration in the Nerves of the Limbs, J. Physiol. **31**:418, 1904. Langley, J. N.: Observations on Denervated Muscle, J. Physiol. **50**:335, 1915-1916; On the Separate Suture of Nerves in Nerve Trunks, Brit. M. J. **1**:45 (Jan.) 1918.

9. Pollock, L. J.: The Clinical Signs of Nerve Injury and Regeneration, Surg., Gynec. & Obst. **30**:472 (May) 1920.

10. Tinel, J.: Nerve Wounds (Monograph), New York, William Wood & Co., 1917.

11. Bénisty, Mme. Athanassio: Formes cliniques des lesions des nerfs, Monograph, Paris.

12. Lucas, K.: On the Optimal Electric Stimuli of Normal and Curarized Muscles, J. Physiol. **34**:372, 1906; On the Optimal Electric Stimuli of Muscle and Nerve, ibid. **35**:103, 1907; The Analysis of Complex Excitable Tissues by Their Response to Electric Currents of Short Duration, ibid. **35**:310, 1907; On the Rate of Development of the Excitatory Process in Muscle and Nerve, ibid. **37**:459, 1908.

13. Lapicque, L.: Sur la theorie de l'excitation electrique, J. de physiol. et de path. gen. **10**:601, 1908; Conditions physiques de l'excitation electrique, J. de physiol. et de path. gen. **11**:1009, 1909; Techniques nouvelles pour l'electrodiagnostic, Compt. rend. Acad. d. sc. **161**:643 (Nov. 22) 1915; Presentation d'un chronaximétre clinique, Compt. rend. Soc. de biol. **78**:695, 1915.

nerve supply and those without any. Adrian [14] confirmed this on human muscles and showed, as we shall see later, that a muscle whose nerve has degenerated requires a current of longer duration to cause a contraction than does a muscle with normal nerve supply, and that all currents are of far shorter duration than can be obtained with ordinary apparatus. To obtain these very short currents Lucas [12] devised his pendulum and Lapicque [13] his "chronaximeter."

For these reasons, therefore, we undertook some experiments on sutured nerves to determine whether by applying the principles laid down by Lucas, Adrian and Lapicque for differentiating normal and degenerated nerves we might throw some light on these questions.

It at once became apparent, however, that there were certain inherent objections to the Lucas pendulum for clinical purposes. It is very heavy and practically nonportable, expensive in construction and difficult to keep in adjustment. Lapicque's clinical chronaximeter uses keys in the circuit, as does Lucas', which are a source of considerable mechanical trouble. For these reasons we have devised, with the assistance of Professor Lindley Pyle, professor of physics at Washington University, an apparatus which we feel does away with these objections.

DESCRIPTION OF INSTRUMENT BY PROFESSOR LINDLEY PYLE

The problem was to incorporate into an electrical circuit an apparatus which could be opened and closed under the control of the operator and permit the flow of a current for a definite and measurable interval of time, approximately only a few ten thousandths of a second. The apparatus was to be so adjustable that the time interval of current flow could be increased by steps up to the order of a hundredth of a second. It was to be so reliable and constant in action that any chosen current pulse could be repeated as to duration of flow at any time the operator required it. Furthermore, the apparatus was to be light and portable yet sufficiently robust to insure permanency in its time constants. For this reason the method of the heavy topped pendulum as used in the Lucas pendulum was discarded and recourse was had to a spring driven device. After several weeks of experimentation the apparatus pictured in Figure 1 was found to fulfil the required conditions.

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[14] Adrian, E. D.: The Electrical Reactions of Muscles Before and After Nerve Injury, Brain **39**:1, 1916; The Recovery of Conductivity and of Excitability in Nerve, J. Physiol. **50**:345 (Sept.) 1916; Physiological Basis of Electrical Tests in Peripheral Nerve Injury, Arch. Radiol. & Electroth. **21**:379 (May) 1917; Conduction in Peripheral Nerve and in the Central Nervous System, Brain **41**:23 (June) 1918; Response of Human Sensory Nerves to Currents of Short Duration, J. Physiol. **53**:70 (Sept.) 1919.

A light aluminum wheel approximately 8 inches in diameter is mounted on a ball-bearing shaft fastened to a bed-plate of brass $3/16$ inch in thickness. One end of a helical coil of steel wire is secured to the bed-plate, the other end being fastened to the wheel. The fundamental idea is to wind up the spring by a rotation of the wheel to a definite position. The wheel, on being released, acquires a high peripheral speed and then automatically brings into action a sliding contact of an attached metal brush across a stationary copper plate of variable width mounted close to the wheel rim. A current flows during the time of contact.

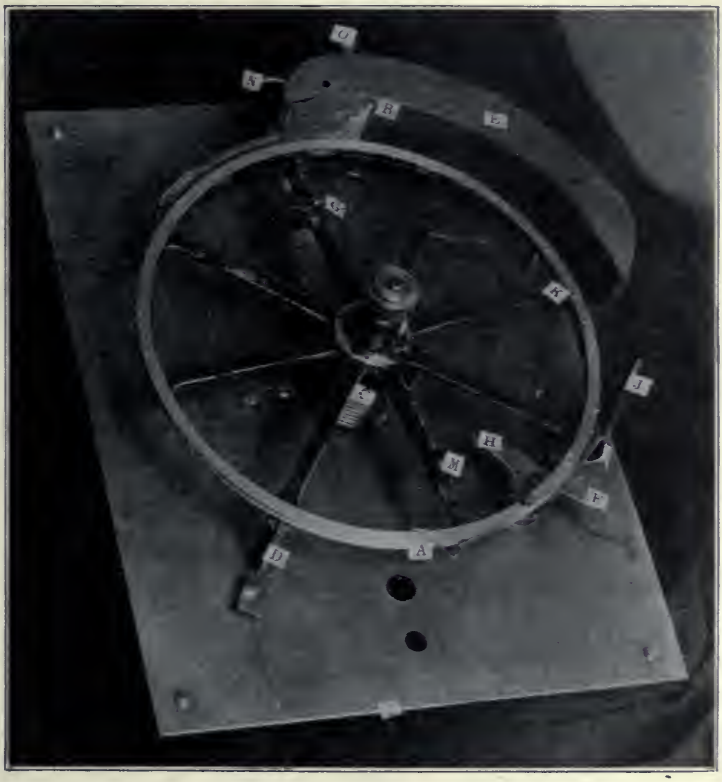

Fig. 1.—Chronomyometer.

Referring to Figure 1, the knob *M* is grasped by the hand and the wheel is rotated right-handedly through about one and a half revolutions. A trigger *D* is then raised to engage with a pin *K* mounted on the lower side of the wheel rim. The mechanism is now "set," ready for operation, and awaits only the depression of the trigger, *D*. A piece of spring-brass wire is mounted on the periphery of the wheel as shown at *A* and constitutes the brush referred to. The outer angle of the wire brush is faced with a strip of platinum soldered to the wire. The block *E* is made of nonconducting red fiber composition so shaped as to have a curved surface concentric with the axis of the wheel. Embedded in this fiber and inlaid so as to be flush with its surface is a piece of heavy-gage copper, *B*, cut into five "steps," or widths, as indicated. A binding post, *O*, is in metallic connection with the copper plate, *B*, by means of a screw penetrating the fiber block. A second binding screw (not shown) is soldered to the brass bed-plate. The fiber block is supported on two brass rods that run through two holes in the bed-plate. A set-screw at *N* may be clamped against one of the support rods so that the fiber block may be set at any desired position. A leather-faced brake-shoe is held away from the outer face of the wheel by a trigger *F*.

The mechanism being set for action and included in the desired electrical circuit by connections to its binding posts, the trigger *D* is pressed and the wheel gathers speed under the action of the stressed spring *C*. The spring-wire brush, *A*, ultimately rides up upon the fiber block, *E*, and, dragging along its smooth surface under a firm pressure, it crosses the copper plate, *B*, at high speed closing the electrical circuit for a definite interval of time. Just after *A* has broken contact with *B* a strip of brass swinging from a pivot mounted on a wheel-spoke at *G* strikes *H* and disengages the trigger *F*. A powerful spring attached to *J* throws the brake-shoe into contact with the periphery of the wheel and brings it to rest before the inertia of the wheel puts a backward twist into the spring, *C*, and before the brush, *A*, passes *B* the second time.

It was found necessary to give the brush at least a 4-inch travel along the fiber block before it crossed the plate *B* in order that any vibration and chattering of the brush due to the initial impact of the brush with *E* might be damped out before the closing of the circuit occurred—otherwise the contact was uncertain. It is desirable to wipe the rubbing surfaces of *B* and *A* and *E* with a piece of chamois to remove dust before each trial. At frequent intervals the faces of *A* and *B* should be wiped with a piece of chamois impregnated with the finest emery dust. With these precautions one may feel assured that at any time a current pulse may be reproduced of unvarying time lapse for any chosen position of the contact plate, *B*.

The duration of contact for each of the five widths of *B* were obtained by an electrical method. A nonabsorbing mica condenser of known capacity was charged through a known resistance by a long-time contact with a battery. The accumulated charge was discharged through a ballistic galvanometer, and the throw noted. With the same circuit constants the condenser was given a short-time charge through the contact-maker under discussion and the ballistic throw corresponding to the short-time charge noted. By a formula known to physicists the duration of the short-time contact was calculated.

The duration of contact for each of the widths of plate were found to be 0.00015 second, 0.00033 second, 0.00065 second, 0.0008 second and 0.009 second. From these figures it is readily determined that each 1 mm. width of copper plate produces a contact approximately 0.000082 second in length. It is possible to secure any value of current duration desired by having a series of copper plates, *B,* of varying widths.

The instrument described we have called a "chronomyometer" because it enables one to measure the time of flow of a current necessary to cause a muscle to contract whether the nerve supply is intact or degenerated.

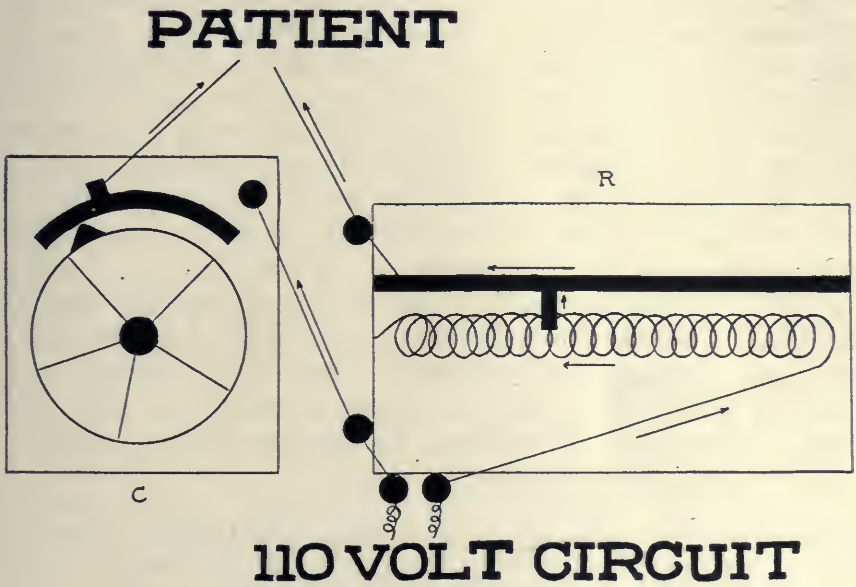

Fig. 2.—Diagram of apparatus.

Prolonged use seems to show that the device is consistent in its action and that any possible variations in the elastic properties of the driving spring are inappreciable.

Figure 2 is a diagram of the electrical apparatus and connections when in use. The chronomyometer, *C,* is in series in the circuit so that the current is flowing only when the brush, *A,* of Figure 1 is in contact with the plate *B* of Figure 1. A resistance coil, *R,* is also placed in the circuit in series so that the voltage of the current used could be varied from 0 to 110 volts. The amperage varies between 6 and 8 milliamperes. A direct current must always be used, and if only an alternating current is available, the direct current may be generated by a small direct current dynamo which is driven by an alternating current motor.

In testing a patient a large indifferent electrode is connected to the positive pole (anode) and an ordinary 1 cm. diameter stimulating electrode to the negative pole (cathode).

The arbitrary values of the duration of the current which the chronomyometer delivers were selected because we felt that any shorter steps would be of no clinical value and would make the procedure too complicated. A nerve-muscle-complex of 0.0008 second was selected as the longest for it was felt that in exceptional cases, at least, a current of longer duration might fall within the limits of a rapid muscle complex and thus lead to false conclusions.

The method of testing is briefly illustrated by the following example: Suppose we want to test a gastrocnemius that has no voluntary movement. The indifferent electrode is placed on the thigh on the same side, the stimulating electrode on the gastrocnemius motor point, the apparatus is set so that the duration of the current corresponds to the longest nerve-muscle complex, 0.0008 second; start with a voltage of about 30. If no contraction follows, gradually increase the current strength until a contraction is obtained. If we obtain none with 110 volts we consider no nervous tissue is present, and the procedure is repeated using the muscle complex 0.009 second and starting with 10 volts; if this fails to cause a contraction a longer duration of current may be obtained by making the contact by hand. On the other hand, if a contraction follows stimulation with the current that gives the longest nerve-muscle complex, the duration is shortened until the minimum duration, no matter how strong the current, which will cause a contraction is obtained. We also determine the least voltage that is necessary to get a contraction at this minimum duration.

PHYSIOLOGIC PRINCIPLES OF MUSCLE AND NERVE-MUSCLE RELATIONS BASED ON A CONSIDERATION OF THE LITERATURE

The more recent investigations on the properties and electrical phenomena exhibited by muscles and nerves have been carried on primarily by Keith Lucas,[12] Lapicque,[13] Sanderson,[15] Adrian,[14] Gotch,[16] and A. V. Hill.[17] To understand this work properly a clear conception

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15. Sanderson, J. Burdon: The Electrical Response to Stimulation of Muscle, and Its Relation to Mechanical Response, J. Physiol. **18**:117, 1895.

16. Gotch, F., and Burch, G. J.: The Electrical Response of Nerve to Two Stimuli, J. Physiol. **24**:410, 1899; The Effect of Local Injury Upon the Excitatory Electrical Response of Nerve, ibid. **28**:32; The Submaximal Electrical Response of Nerve to a Single Stmulus, ibid. p. 395; Gotch, F.: The Delay of the Electric Response of Nerve to a Second Stimulus, ibid. **40**:250, 1910.

17. Hill, A. V.: A New Mathematical Treatment of Changes of Ionic Concentration in Muscle and Nerve Under the Action of Electric Currents, with a Theory as to Their Mode of Excitation, J. Physiol. **40**:190, 1910.

is necessary of the excitation time of nerves and muscles, the term applied to it by Lucas.[12]

The excitation time is based on two factors: (1) the minimal strength, and (2) the minimal duration of a constant current, that is, a current which reaches a certain voltage immediately and maintains this voltage as long as it is flowing, in contradistinction to a condenser discharge whose current gradually decreases in intensity. It is also important to realize that constant or galvanic currents and faradic currents are the same kind of electricity, faradic differing from galvanic only in that it flows intermittently for short periods of time.

If one stimulates a nerve muscle preparation with a constant current it is found that the contraction of the muscle is dependent not only on the strength of the current, but also on its duration. No matter how strong the current is, that is the voltage, the current must flow a certain length of time in order to get a contraction, and if this is shortened no reaction follows. Conversely, no matter how long the current flows, if the current is not more than a certain strength, no contraction of the muscle will be obtained. Between these extremes as the duration of the current is decreased the strength of the current must be increased to produce a contraction, and vice versa, the duration has to be increased as the strength is decreased. In order to understand the relationship between these two factors, the minimum strength and the minimum duration must be determined in each case. Lucas and Adrian have shown this graphically both in a toad's muscle (Fig. 3)

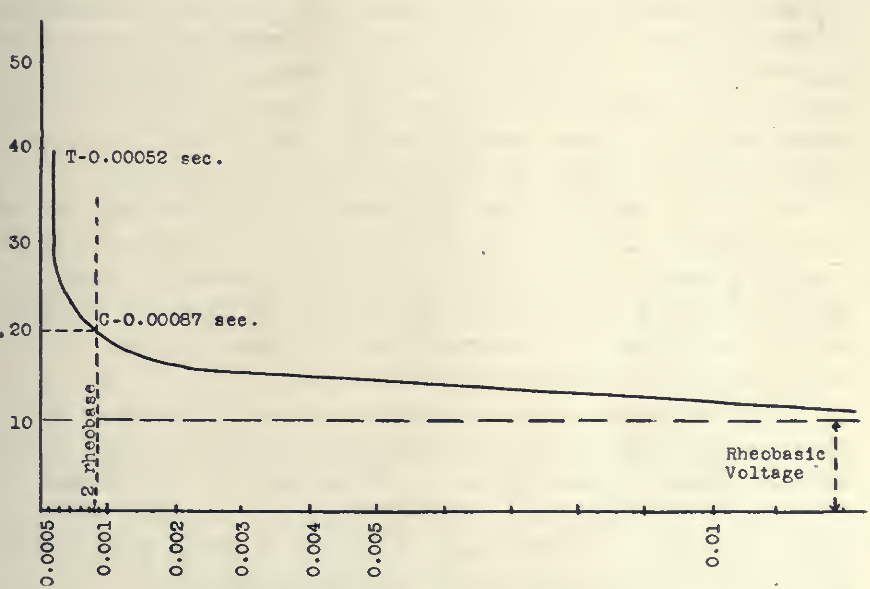

Fig. 3.—Sciatic nerve of toad (Lucas).

and in a human tibialis anticus with intact nerve supply (Fig. 4). The ordinates show the strength of current, the abscissae the duration of the current. The minimum duration of a current necessary to stimulate a muscle without nerve supply is much longer than that necessary to stimulate a muscle with an intact nerve (Fig. 5).

An analysis of these curves shows that at long, or, as they called it, "infinite" duration there is a minimum strength below which no contractions occur, and as the duration is decreased the strength must be increased until a point is reached where, no matter how strong the current, no contractions follow. This minimum of duration is the measure of the excitation time. The minimal strength current of infinite duration necessary to get a contraction, Lapicque[13] called rheobasic voltage. He noted that a sudden change in the curve occurred approximately at a point at which twice the rheobasic voltage was used and the length of time the current flowed with this strength he called chronaxie. Adrian[14] has found that the chronaxie of a human muscle with intact nerve supply was about 0.00016 second while the chronaxie of a muscle whose nerve had degenerated was about 0.01 second.[18]

We want to emphasize that the chronaxie is not the same as the absolute minimum duration of current required to produce a contraction. In a muscle with intact nerve these two points differ slightly, as shown in Figure 4, the difference being 0.00010 and 0.00016 of a second, while when the nerve is degenerated the difference in these points is very great (Fig. 5), 0.003 and 0.01 of a second.

The difference between the chronaxie of nerves and muscles explains why a muscle whose nerve is degenerated does not respond to the ordinary faradic current but only to the galvanic, for the duration of each faradic shock is shorter than the chronaxie of muscle while the galvanic current is always much longer in duration than muscle chronaxie. The repeated shocks of a faradic current make it impossible for the patient to endure a strong enough current to stimulate the muscle when its nerve supply is impaired, and thus it is of limited clinical value.

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[18] The length of the chronaxie of normal muscles and muscles without nerve supply recorded by Lapicque in his first report (Techniques nouvelles pour l'electro-diagnostic, Compt. rend. Acad. d. Sc. **161**:643 [Nov. 22] 1915) agrees very well with Adrian's (The Electrical Reactions of Muscles Before and After Nerve Injury, Brain **39**:1, 1916. Physiological Basis of Electrical Tests in Peripheral Nerve Injury, Arch. Radiol. & Electroth. **21**:379 [May] 1917), but in his second report (Presentation d'un chronaximétre clinique, Compt. rend. Soc. de biol. **78**:695, 1915) it is about ten times as long. As our results correspond to those of Adrian's we feel that his figures are more nearly correct. The difference in Lapicque's figures may be due to the calibration of his chronaximeter.

CLINICAL APPLICATION OF CHRONAXIE

Adrian[14] has used the Lucas pendulum with interrupting keys to vary the duration of the current and a potentiometer to vary the strength of the current. With this apparatus he has determined the curve for a muscle with intact nerve supply (Fig. 4), a muscle without nerve supply (Fig. 5), and a muscle with incomplete division of its nerve (Fig. 6). It will be noted that in Figure 6 the curve has two phases; in reality, therefore, it is fair to assume that there are two separate curves as indicated by the dotted lines; one of these represents the strength-duration curve of a muscle without nerve supply with a chronaxie of 0.004 second (curve A) while the other represents the strength-duration curve of a muscle with intact nerve supply with a chronaxie of 0.0005 second (curve B). This means that if we consider chronaxie as the measure of the excitation time of the tissue we would conclude that 0.004 second meant that only muscle fibers were present. If, however, the true minimum duration of the current is used as the measure of the excitation time of the tissue, it will be seen to be less than 0.0005 second and this would mean that some nerve tissue is present. *We feel that the true minimum duration of the current, no matter how strong the current, is the real measure of the excitation time of the tissues in question and we therefore have disregarded arbitrary chronaxie in our tests.* Cases 4 and 10 illustrate this very well.

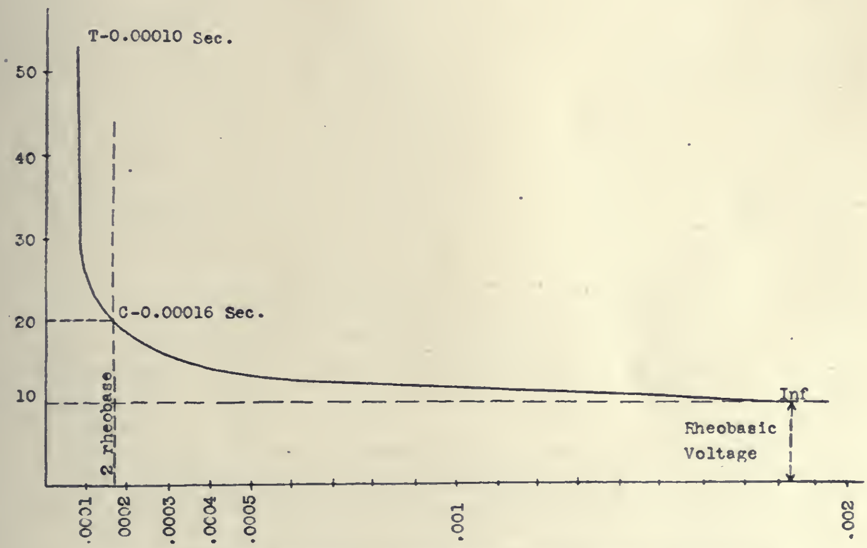

Fig. 4.—Human tibialis anticus, intact nerve supply (Adrian).

Case 4.—On September 18 the rheobasic voltage was 20 V, the chronaxie at 40 V, twice rheobase, was 0.009 second, and thus one would conclude that there was no nerve tissue present. The minimum duration, however, was 0.00033 second with 100 V, and thus we concluded that some nerve fibers were present in the muscles tested and gave the patient a favorable prognosis. The ultimate recovery of voluntary power in these muscles bears out our opinion.

In order to avoid confusion we prefer to use the terms "muscle complex" and "nerve-muscle complex." By muscle complex we mean that the minimum duration of the current necessary to stimulate a muscle falls within the range of time determined clinically and experimentally for muscles without their nerve supply, 0.02-0.004 second; by the term "nerve-muscle complex" we mean that the minimum duration of the current necessary to stimulate a muscle falls within the range of time determined clinically and experimentally for muscles with intact nerve supply, 0.0009-0.00008 second. The terms long, medium and short are added to indicate whether the nerve-muscle complex is normal or approaching normal, the short response being the normal.

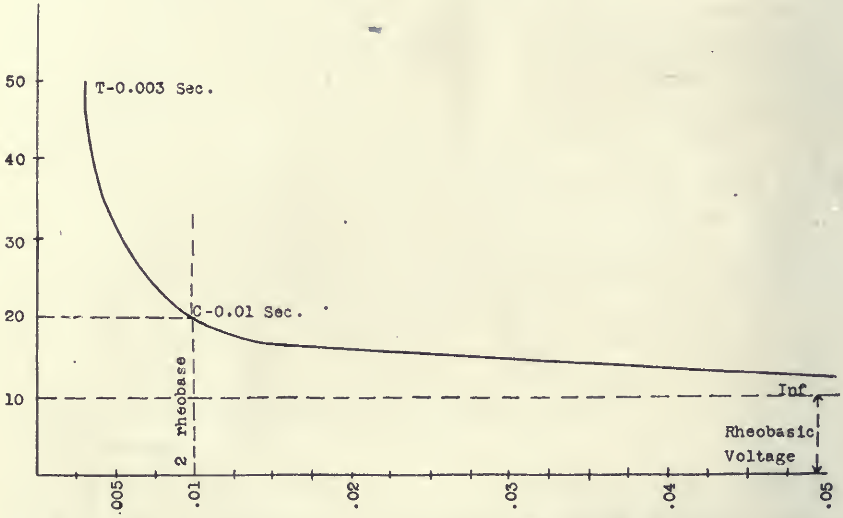

Fig. 5.—Human tibialis anticus, six months after division of sciatic (Adrian).

From the three factors, the type of contraction, the minimum strength of current and the minimum duration of the current, the degree of impairment of the nerve supply and the condition of the muscles are determined, and by repeating these tests at varying intervals the progress of the case may be followed accurately. The changes that occur in these cases may be observed by a study of our protocols.

Before considering our own results it will be necessary to point out what we believe to be the objections to previous methods that have been used for testing nerves and muscles.

DISCUSSION OF OTHER METHODS

Chronaxie.—Adrian [14] considers chronaxie the important criterion of the condition of the tissues but also insists that the full curve should be determined in each instance so that a two phase curve, as shown in Fig. 6, will not be overlooked.

This method has the practical disadvantage, however, of taking hours to make these determinations in cases in which a number of muscles are involved and besides, we believe, the determination of the complete strength duration curve is unnecessary.

He, however, also makes this statement: [14] "A current of 0.004 second will excite nerve fibers if it is strong enough, but it will not stimulate muscle fibers, however strong it may be. So if we could always use a current of this duration and of variable strength there would be no need to determine the full curve." Such a method would be essentially what is done with a faradic current unless Adrian means to use only a single shock instead of the repeated shocks of a faradic current but even then a change in the nerve muscle complex could only be detected by the variation in the minimum strength of current used.

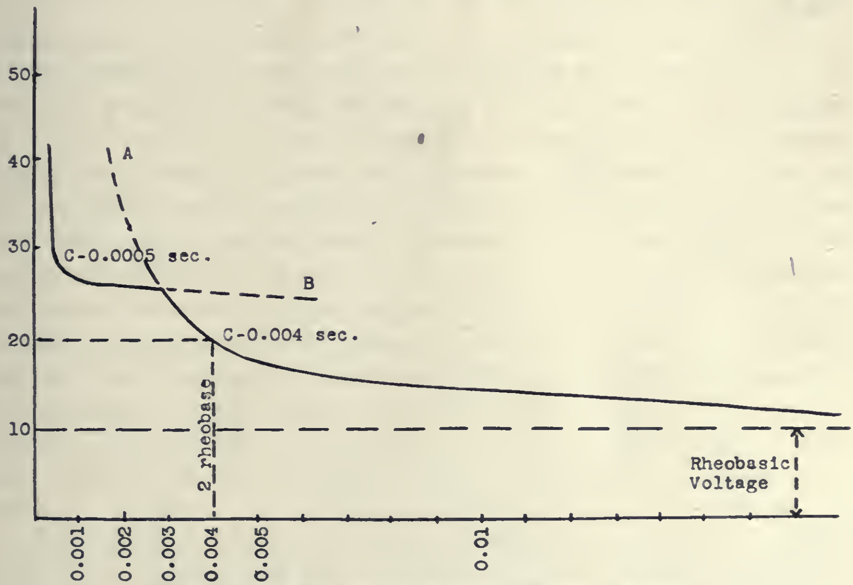

Fig. 6.—Incomplete sciatic injury, human (Adrian).

According to Adrian the important criterion of regeneration is the decreasing strength of current necessary to bring out nerve muscle chronaxie after it has once begun to appear. As will be seen later, we have found that the change in the minimum duration of the current is the most important criterion.

The minimal strength of current will vary with the tissue resistance, temperature of the muscle, etc., even if there were no change in the innervation of the muscle tested. On account of this great variation in tissue resistance the minimum duration of the current and not the minimum strength of the current must be used as the measure of the excitation time, and consequently the determination of the full strength-duration curve is unnecessary.

The objections to chronaxie determinations are that they do not give the true minimum duration and thus facts are disregarded that we believe are of vital importance in determining the regeneration of a nerve. Also true nerve-muscle chronaxie has seldom been observed in injured nerves until regeneration is nearly complete and at that time voluntary movement has begun to appear.

Condensers.—Condenser systems of the Lewis Jones[19] type enable one to test a muscle with currents of different duration, but Jones[19] himself points out that if the current strength is altered the time of discharge of a given condenser is also altered. Hernaman-Johnson[20] has devised an apparatus to change the voltage of Jones condensers, but this does not regulate the time of discharge which is affected by the voltage. The time of discharge for different voltages could be calculated, but for clinical purposes this is impracticable. Furthermore, a condenser of known capacity charged with a constant voltage discharges in a definite time, but as it discharges the intensity of its current decreases gradually to zero. Roberts[21] has pointed out that a portion of such a discharge is below the minimum strength of a current, at infinite duration, necessary for stimulation, and this portion is ineffective. Since the resistance of tissues varies greatly at all times, the size of the minimum strength current necessary to stimulate a muscle will vary. It follows, therefore, that the amount of current which is below the minimum strength will vary with this resistance, and the duration of the effective part of a condenser discharge varies greatly even though a given condenser is charged with the same voltage. For this reason the value of the constant current becomes apparent for it attains its maximum voltage at once, and this is maintained throughout the period of flow.

For these reasons it is obvious that the results obtained with condenser discharges when compared to tests on normal muscles or previous tests on any muscle are unreliable.

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[19] Jones, H. L.: The Use of Condenser Discharges in Electrical Testing, Proc. Roy. Soc. of Med. **6**:49 (Jan.) 1913; Medical Electricity, Ed. 6, London, 1913.

[20] Hernaman-Johnson: Use of Condensers in Diagnosis, Prognosis and Treatment of Muscles Following Nerve Injuries, Lancet **1**:396, 1916.

[21] Roberts, F.: Degeneration of Muscle Following Nerve Injury, Brain **39**: 297, 1916.

Galvanism and Faradism.—The objections to this method of testing muscles electrically have been pointed out by many observers and may be summarized as follows: First, faradism usually returns at about the same time that voluntary movements return, and therefore is of little clinical value. This fact does not appear to be in harmony with the previously stated physiologic facts, but this discrepancy is explained by the fact that the faradic current is a repeated series of shocks, each one having the duration of a long nerve-muscle complex. In cases of regenerating nerves before voluntary movement has returned we shall see that it is necessary to use currents of relatively strong voltage to produce contractions. When this voltage is used with an induction coil, the pain is so great that it is unbearable and in addition the current spreads to surrounding healthy muscles rendering conclusions difficult or impossible. Second, the duration of the faradic shock cannot be varied and would be of no value in showing the progress of a case even if a response could be elicited before voluntary contractions returned. Third, the comparison of the response to negative and positive threshold galvanic currents varies in normal muscles, and when strong currents are used it is difficult to distinguish between the return to normal of stimulated antagonist or neighboring muscles, and the slow contraction of the muscles being tested. The threshold strength varies several milliamperes if exactly the same motor point is not stimulated each time. This renders tests from month to month of little value. Fourth, the entire procedure is time consuming, requires considerable experience and is difficult to interpret.

RELATION OF INDUCED WAVES OF OPENING AND CLOSING (LAUGIER[22])

This method supplies a means of testing a muscle with varying strength of current but only the duration of one muscle complex and one nerve-muscle complex. These values are dependent on the individual coil employed, and a ballistic galvanometer is necessary to determine the strength of current used. The results must be expressed in relative figures derived by dividing the current used in the closing wave by the current used in the opening wave. Objections to this method are: First, the variable is the strength of current which is dependent on many other factors than the condition of the muscle in question; second, the duration of the current cannot be varied; third, the method is technically difficult to carry out; and fourth, the apparatus is not readily transported.

EXPERIMENTAL DATA

In the course of some experiments on methods of repair of peripheral nerves in dogs, the muscles innervated by these repaired nerves were tested electrically with our chronomyometer. Other experiments were carried out in order to test the changes in the nerve muscle complex during degeneration and regeneration of an injured nerve. The nerves were exposed under ether anesthesia from time to time under strictest aseptic precautions, and thus by direct stimulation of the nerve trunks with the faradic current we determined when regeneration had occurred and the results compared with the chronomyometer findings. Nerves were excised from time to time in order to check up by histologic studies the stage of regeneration of the nerves. All specimens were stained by the Silver-Pyridin method described by Ranson.[3] In all we have done eight nerve sutures, and fifty observations were made on them. (The factor of pain was entirely eliminated by the use of ether anesthesia.)

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[22] Laugier: Biol. méd. 1914, p. 89.

A study of the tables and protocols of our experiments reveals the following facts:

The nerve muscle complex remains normal for a period varying from forty-six to seventy hours after cutting the nerve trunk (Exper. 89, 91, 93, 113 and 121). In no case was a nerve-muscle complex found on a dog after seventy-five hours.

When the irritability of the nerve begins to diminish it changes rapidly and within from two to five hours only the muscle complex is present. In Exper. 93 the nerve-muscle complex did not begin to disappear until some time between the fiftieth and sixty-eighth hour, but then in one hour and forty minutes it changed from 0.00033 second to 0.00065 second, to 0.0008 second, and then to 0.009 second, the muscle complex. Throughout these tests the same voltage was always used.

As regeneration occurs the slow nerve muscle complex appears first, and then gradually the nerve-muscle complex shortens until it finally becomes normal, 0.00015 second. In these experiments the animals were anesthetized so that the factor of pain could be eliminated and the strength of the current could be increased to the point at which the current was seen to spread to normal muscles.

Faradic response was only elicited when the nerve muscle complex was normal. It could not be elicited earlier even under anesthesia, for when currents as strong as those used with the chronomyometer were used with faradic stimulation, the current spread to normal muscles so that accurate observations were impossible. Whenever the nerve-muscle complex begins to appear it is an evidence of return of regeneration. This we have checked up by histologic examination and by direct stimulation of the nerve trunk (Exper. 51, 81, 91, 99, 113 and 121).

Exper. 51.—Double lateral anastomosis of peroneal nerve to tibial nerve, tested 221 days after operation and nerve-muscle response 0.00015 second in muscles of peroneal and tibial distribution. Central tibial nerve cut and tested eighteen days later, showed 0.00015 second over peroneal nerve distribution and 0.009 over tibial nerve (with and without anesthesia). Direct stimulation of nerve trunks gave no tibial nerve response but normal peroneal response. Microscopic sections of tibial nerve showed no axis cylinders.

Summary: Nerve-muscle complex before cutting, muscle complex eighteen days after, confirmed by direct stimulation of nerve trunk and histologic examination.

Exper. 81.—Double lateral anastomosis of peroneal nerve to tibial nerve, tested 106 days later. Reaction: 0.00015 second in anterior and posterior muscles of leg though those innervated by peroneal nerve very weak. Direct stimulation of nerve trunks gave active response of those innervated by tibial nerve but very weak over peroneal nerve distribution. Microscopically there were fewer axis cylinders in the peroneal nerve than in the tibial nerve.

Summary: Weak muscular response to 0.00015 second checked by direct stimulation of nerve trunk and microscopically.

Exper. 93.—Left sciatic cut and resutured. Nerve-muscle complex 0.00015 second before cutting and for 50 hours after, 0.00033 second 68 hours after operation, 0.00065 second 50 minutes later, 0.0008 second 20 minutes later, 0.009 second 30 minutes later. The voltage was the same in all tests.

Summary: Nerve-muscle complex normal 50 hours after cutting, almost normal 68 hours after cutting but 1 hour 40 minutes later only muscle complex present, that is, irritability of nerve normal for 68 hours after cutting but irritability lost rapidly when it started to decrease.

Exper. 99.—Nerve tested three months after regeneration and 0.00015 second response found, confirmed by direct stimulation of nerve trunk.

Exper. 113 and 121.—Opened three days after cutting the nerve, and direct stimulation of its trunk failed to cause muscular contractions. Only muscle complex present. Histologically beginning degeneration.

Summary: Muscle complex after three days; no response to stimulation of nerve trunk and beginning degeneration histologically.

Exper. 89.—Left sciatic cut and resutured—motor points of left leg tested in each case. Details of this experiment are given in Table 1.

Exper. 91.—Left sciatic cut and resutured—motor points of left leg tested each time. The details are given in Table 2.

CLINICAL CASES

In the past year about thirty-five cases of peripheral nerve lesions have been tested with the chronomyometer. Many of these patients have been followed with frequent examinations until recovery was complete. Others have not completely recovered as yet, while some have either not returned for examination or the examination was not considered of value, as in cases in which the lesion involved the central neuron.

In each case the following points were studied: sensory changes, trophic disturbances, voluntary control of muscles, functional disability and electrical tests (the chronomyometer was used in all cases and faradism in many). We also looked for Tinel's sign and the pinching test of Athanassio Bénisty. Of the thirty-five cases examined, the

TABLE 1.—Details of Experiment 89

Date and Time of Examination	Duration of Current in Seconds	Approximate Strength of Current in Volts	Faradism
6/28/20 Before operation	0.00015	..	+
45 minutes later	0.00015		
2½ hours later	0.00015	60	
4 hours later	0.00015		
9 hours later	0.00015		
24 hours later	0.00015	..	+
46 hours later	0.009	..	—
7/ 8/20	0.009	..	—
7/22/20	0.009	..	—
8/21/20	0.009	..	—
9/ 3/20	{0.0008	21	—
	{0.00066?	42	—
9/13/20	{Posterior muscles 0.00033	42	—
	{Anterior muscles 0.00015	42	—
9/20/20	{0.00033	22	?
	{0.00015	28	
10/11/20	0.00015	16	+ but very weak
10/18/20	0.00015	16	+ with good contractions

Summary: Left sciatic cut and normal nerve-muscle response for at least twenty-four hours and only muscle complex after forty-six hours. First nerve-muscle complex sixty-seven days after operation and duration of current gradually shortened to normal in thirty-eight days. Faradism was weakly present at this time, therefore chronomyometer test showed regeneration thirty-eight days ahead of faradism. Regeneration confirmed histologically.

TABLE 2.—Details of Experiment 91

Date and Time of Examination	Duration of Current in Seconds	Approximate Strength of Current in Volts	Faradism
6/28/20 Before operation	0.00015	57	+
½ hour after operation	0.00015	57	+
20 hours later	0.00015		
50 hours later	0.00015		
68 hours later	0.00015		
69 hours later	0.00015		
70 hours later	0.00015		
75 hours later	0.009		
7/ 8	0.009		
7/22	0.009	..	—
8/21	0.009		
9/ 3/20	0.009		
9/13	0.009	..	—
9/20	0.009	..	—
10/11	{0.00033 doubtful at	33	
	{0.00033 definite at	55	—
10/18	0.00015	42	—
10/26	0.00015	22	{± anterior muscles {+ posterior muscles
11/ 6	0.00015	14	+

Summary: Nerve-muscle complex lost between seventy to seventy-five hours began to return after from eighty-two to one hundred and two days and completely returned after one hundred and nine days, while faradism first returned after one hundred and seventeen days. Regeneration was confirmed microscopically.

protocols of only twenty-one are recorded as the others threw no light on this investigation. We record here only the positive findings in each of these cases.

A study of the twenty-one cases reported and Table 3 lead us to the following conclusions:

1. As regeneration occurs the long nerve-muscle complex appears first and as regeneration continues the nerve-muscle complex shortens until finally it reaches the value of a normal nerve-muscle complex. The early appearance of a long nerve-muscle complex enabled us to recognize that there was beginning regeneration. Thus an earlier diagnosis and an earlier favorable prognosis was possible. The ultimate recovery of all patients in whom this was observed has confirmed this opinion.

The minimum voltage necessary to cause contractions may remain practically the same at each test although the duration shortens, but in some instances it may vary considerably from time to time and this is due to the variation in tissue edema, temperature of the muscles, etc.

TABLE 3.—TIME CHRONOMYOMETER RESPONSE PRECEDED OTHER SIGNS OF REGENERATION

Case No.	Diagnosis	Before Faradism	Before Voluntary Contractions	Before Decrease in Anesthesia	Remarks
1	Left sciatic paralysis	3 months	3 months	2 months	
2	Incomplete brachial plexus injury	3 months	3 months	5 months	
3	Right sciatic incomplete	4 months	2 months	2-4 months	
4	Left sciatic paralysis	6 months	1-2 months	No gain	
5	Poliomyelitis	Not tested	2 months		
6	Bell's palsy	No gain	23 days	....	No degeneration of nerve
7	Left facial paralysis	Not tested	1-3 months		
8	Left facial paralysis	1 month	23 days		
9	Bell's palsy	Not tested	1 week	....	No degeneration of nerve
10	Right facial paralysis	Probably 3 months	Probably 3 months		
11	Left facial paralysis	Not tested	1 week	....	No degeneration of nerve
12	General polyneuritis	Faradism too painful			

In Table 3 it will be noted that the nerve-muscle complex returned from one to six months before faradism, one week to three months before voluntary contractions appeared and from zero to five months before anesthesia decreased. The greatest gain was observed in cases of injury to the long nerves and the least gain in the facial nerve lesions. This is, of course, to be expected for the distance the regenerating axis cylinders must grow and the size of the muscles innervated influences markedly the time between beginning and complete recovery. The time between degeneration and regeneration of the nerve determines to a large extent the amount of atrophy of the muscles, no matter how well they are cared for.

2. The nerve-muscle complex had disappeared by the fifth day in the posterior group of muscles in Case 3. This was the only case we saw

early enough to enable us to determine when the nerve-muscle complex first disappeared. This agrees with our animal experiments in which the nerve-muscle complex disappeared invariably at the end of seventy-six hours after complete severance of the nerve.

Adrian has reported a case of facial paralysis in which the nerve muscle chronaxie disappeared between the fifteenth and sixteenth day. This would indicate that in human nerves there is considerable variation as to when the nerve muscle complex is lost.

3. The presence of the nerve-muscle complex in cases in which there is no voluntary movement is a valuable prognostic sign as illustrated by Cases 6, 9 and 11. In these cases because of the normal nerve muscle complex we gave a good prognosis for early recovery. Therefore, whenever the nerve-muscle complex is present, even if there is no voluntary movement, no surgical interference should be considered.

4. Faradic response did not return until the nerve-muscle complex was 0.00033 second or shorter, that is, not until the irritability of the nervous tissue reached normal limits and voluntary movements were beginning to return. Case 12, in which hyperalgesia was present, illustrates strikingly the difficulty of testing with faradism on account of the pain, for even with weak currents the repeated stimulus is painful while a single shock of shorter duration is well tolerated by the patient.

5. Voluntary contractions returned at about the same time that faradism returned or when the nerve-muscle complex had reached normal limits.

6. The decrease in the area of anesthesia may occur parallel with the appearance and shortening of the nerve-muscle complex or it may lag considerably behind. In cases of motor nerve lesions, as in the facial, this part of the examination is, of course, useless, and conversely the electrical test at first seems to be useless in lesions of sensory nerves. That this is probably not true is suggested by Adrian's[14] work in which he determined the strength-duration curve for sensory nerves. This suggests the same possibilities for sensory nerves as we have found for motor nerves although we have made no observations on this point.

7. In incomplete nerve lesions, as in Case 3, in which only a few fibers remain intact, the detection of one muscle showing even the slowest nerve-muscle complex may be of great diagnostic and prognostic value. In this case it saved the patient an exploratory operation and recovery followed in due time.

8. In extensive lesions as those of a plexus, Case 2, or a high sciatic lesion, Case 17, the progressive lengthening of the nerve-muscle complex as one proceeds distally from the lesion may mean one of two things. If the case is seen early it means that the injury is incomplete,

while if the case is seen late it means either that the injury is incomplete or that regeneration has begun. The latter point is easily determined by a subsequent examination. In either case we feel that the prognosis is usually good and that operation is not indicated until it has been proved that regeneration is stationary after repeated examinations.

9. The only case of poliomyelitis cited, Case 5, shows a change from the muscle complex to the normal nerve-muscle complex in two months in some of the muscles, which we interpret as meaning that the anterior horn cells were regaining their activity. This method offers a possible means of determining with mathematical accuracy when the process of recovery in the affected nerves in poliomyelitis has come to a standstill.

10. When patients were seen a few months after injury and showed complete paralysis of a given nerve we delayed making a prognosis or stating whether operation was advisable until the axis cylinders might have had time to reach the nearest muscle distal to the lesion. We used as a basis for estimating when this time should be the measuring of distance from the lesion to the motor point of the nearest muscle. This distance in centimeters gives the number of weeks it should take the regenerating axis cylinders (if regenerating) to reach the nearest muscles and thus be detected by the electrical test. One cm. per week seems to be a conservative average rate of regeneration, but it must be used with judgment for each case varies and the entire picture must be considered. Cases 1 and 4 show the value of waiting in old cases. We feel, however, that a case seen early, unless the injury is only a few centimeters from a motor point, is entitled to an exploratory operation if no signs of recovery are present at the end of from six to eight weeks.

11. We have some evidence to indicate that there is some relation between the number of axis cylinders in a nerve and the length of the nerve-muscle complex. In Case 3 we were able to study the popliteal nerve in cross section and found that 5 cm. below the knee, axis cylinders were present in very large numbers (appeared like a normal nerve) while 5 cm. distally from that point the number of axis cylinders was definitely decreased. This decrease continued until at the ankle there were about one or two axis cylinders to a low power field. The electrical response of the gastrocnemius was shorter than that of the tibialis anticus, and as the former muscle gets its innervation higher up the variation in the length of the nerve-muscle complex may have been dependent on the number of axis cylinders present. It may of course be possible that the variation in the threshold duration necessary to produce a contraction accounts for the difference in electrical reaction at different stages of regeneration. Further observations are necessary to clear up this point.

Case 1.—B. S., bullet wound in thigh January, 1920, tourniquet applied on lower third of thigh for two days to control hemorrhage, followed by paralysis of left leg.

TABLE 4.—Findings in Case 1

Dates of Examinations	Motor Points Tested	Duration of Current in Seconds	Approximate Strength of Current in Volts	Type of Contraction	Voluntary Contractions	Anesthesia to Pin Prick	Remarks.
7/10/20	All of left leg	0.009	85	Fair	None	That of sciatic lesion	Trophic ulcer of heel and great toe; massage and electricity started; impression-degeneration of sciatic nerve below thigh
	All of right leg and left thigh	0.00038	82	Good	Normal	None	
8/24/20	Soleus and median head of gastrocnemius	0.00066	90	Weak	None	Same as on 7/10	Muscles somewhat spastic; good prognosis given; faradism negative
	Tibialis anterior	0.0008	90	Weak	None	Same as on 7/10	
10/20/20	Soleus and median head of gastrocnemius	0.00033	105	Weak	None	To mid-leg lateral and below malleolus medial	Edema of leg, infection of toes; no massage for two months; faradism negative
	Tibialis anterior	0.00015	88	Weak	None		
11/30/20	Anterior and posterior muscles of left leg	0.00015	95	Fair	Slight	Sole of foot and one inch up all around foot	Faradism weak; infection improving

Summary—Diagnosis: Complete degeneration of sciatic nerve below thigh but prognosis delayed to allow regenerating fibers (if present) to reach muscles and skin of leg. Eight months after injury long nerve-muscle complex first appeared and good prognosis given. Three months later nerve-muscle complex was normal, slight voluntary movements were present and anesthesia was greatly reduced. Gain of three months over voluntary movements and faradism and two months over sensory. (In another similar sciatic lesion the sensory paralleled the nerve-muscle response.)

TABLE 5.—Findings in Case 2

Dates of Examinations	Motor Points Tested	Duration of Current in Seconds	Approximate Strength of Current in Volts	Type of Contraction	Voluntary Contractions	Anesthesia to Pin Prick	Remarks
4/23/20	Biceps brachii	0.00033	75	Fair	None	Up to just above elbow posterior and about 6 cm. anterior; sensation of current and muscle contractions present down to elbow	Because of progressive shortening of current duration as arm was ascended a good prognosis given; no reaction to faradism below shoulder
	Teres major	0.00033	75	Fair	None		
	Median nerve	0.00065	75	Fair			
	Ulnar nerve	0.00065	75	Fair			
	Flexor carpi radialis	0.009	75	Good	None		
	Extensor indicis proprius and muscles of hand	0.009	75	Fair	None		
5/13/20	Biceps	0.00033	72	As before	As before	As before	Faradism negative in all
	Ulnar nerve	0.00065	75				
	Median nerve	0.00065	75				
	Flexor carpi radialis	0.009	75				
	Extensor indicis proprius and muscles of hand	0.009	75				
6/16/20	Biceps	0.00015	70	Poor	As before	As before	Faradism negative in all
	Median nerve	0.00033	75	Poor			
	Ulnar nerve	0.00033	75	Fair			
	Flexor carpi radialis	0.009	75	Good			
	Extensor indicis proprius and muscles of hand	0.009	75	Fair			
7/20/20	Biceps	0.00015	75	All stronger than on 6/16/20	Slight contractions of muscles above elbow	As before	Faradism positive in biceps, triceps and brachialis; negative in all others
	Triceps	0.00015	75				
	Brachialis	0.00015	75				
	Ulnar	0.00033	75				
	Flexor carpi radialis	0.009 0.0008 doubtful	75				
	Extensor indicis proprius and muscles of hand	0.009	75				
9/28/20	Biceps	0.00015	85	More active than on 7/20/20	Very slight flexion of elbow and supination; movements of shoulder girdle active	As before but pinching is felt numbly over entire lateral surface of forearm and hand but not on median surface	
	Triceps	0.00015	85				
	Brachialis	0.00015	85				
	Ulnar	0.00015	75				
	Flexor carpi radialis	0.00080	85				
	Extensor indicis proprius and extensors of wrist	0.00080	85				
	Flexor of wrist	0.00080	85				
	Muscles of hand	0.009	55				
11/30/20	Biceps, triceps, brachialis, ulnar	0.00015	85	Fair	Supination, pronation, flexion and extension of elbow abduction of arm weak but definite	As on 9/28/20 except anesthesia to just below elbow and pinching felt numbly over all of forearm and hand and first phalanx of fingers	
	Extensors of wrist	0.00080	92	Fair			
	Flexor carpi radialis and flexor of wrist	0.0008	92	Fair			
	Muscles of hand	0.009	92	Fair			
3/16/21	Biceps, triceps, brachialis and ulnar	0.00015	85	Good	As on 11/30 but much stronger; very slight flexion of fingers	From middle of hands distal; from elbow and midarm-medial down cannot distinguish between head and point of pin; deep muscle and joint sense corresponds in quality to above	Shoulder, elbow, wrist and finger joints show from 20-40% restriction of motion; atrophy of muscles of hand and forearm more marked since patient has not had treatment past 2 months; faradism as on 7/20/20
	Extensors of wrist	0.0008	100	Only fair			
	Flexor carpi radialis	0.0008	100	Only fair			
	Flexors of wrist	0.0008	100	Only fair			
	Muscles of hand	0.009	75	Only fair			

Summary: Shows a progressive lengthening of the minimum duration of current; therefore good prognosis given; a slow change of muscle complex to nerve-muscle complex in many muscles and a shortening of nerve-muscle complex in others; a return of voluntary movement in those muscles whose complex shortened to normal; a reduction in anesthesia; a gain with the chronomyometer of 3 months over faradism, 3 months over voluntary movements and 5 months over reduction of anesthesia.

CASE 3.—N. K., popliteal aneurysm ligated in upper part of popliteal space, June 6, 1920.

TABLE 6.—FINDINGS IN CASE 3

Dates of Examinations	Motor Points Tested	Duration of Current in Seconds	Approximate Strength of Current in Volts	Type of Contraction	Voluntary Contractions	Anesthesia to Pin Prick	Remarks
6/ 3/20	Right leg; all points	Infinite	70	None	None	Lower lateral surface of leg	No contractility or irritability of muscle—ischemid probably
	Right thigh and left leg	0.00033	50	Good	Normal	Decrease over balance	
6/ 7/20	Tibialis anticus	0.0008	70	Fair	None	That of sciatic nerve paralysis	Faradism negative
	All other on right leg	0.009	70	Fair	None		
6/15/20	All in right leg	Same on 6/7/20	...	....	....	....	Faradism negative
8/13/20	All in right leg	0.0008	70	Fair	None	Same as 6/7/20 practically	Faradism negative
10/16/20	Right leg and anterior group	0.0006 definite 0.00033 doubtful	105	Good	Slight	Foot and ankle	Trophic ulcer on heel; patient has very acute purulent arthritis of right knee; faradism positive; some edema
	Posterior group (right leg)	0.00033	105	Good	Slight		
10/23/20	....	....	...	....	....	....	Midthigh amputation right and nerve from knee to ankle studied histologically

Summary: Nerve-muscle complex returned 4 months ahead of faradism, between 2-4 months before sensory anesthesia decreased, and 2 months before voluntary contractions. On June 3, 1920, a diagnosis of ischemic paralysis was made but on June 7, 1920, it was clearly that of sciatic paralysis (incomplete). A good prognosis was given. The length of the nerve-muscle complex gradually shortened until 4 months later when it was within normal limits for the muscles of the leg and slight voluntary contractions were present; those of foot not tested. Histologically, cross sections of tibial nerve showed approximately normal number of axis cylinders 5 cm. below knee, fewer 10 cm. below knee and so on until at ankle there was about one to a low power field. This checks up with the electrical findings.

Case 4.—G. B., fracture of distal end of left femur on March 21, 1920.

TABLE 7.—Findings in Case 4

Dates of Examinations	Motor Points Tested	Duration of Current in Seconds	Approximate Strength of Current in Volts	Type of Contraction	Voluntary Contractions	Anesthesia to Pin Prick	Remarks
6/23/20	All left leg....................	0.009	70	Fair	None in foot	That of a sciatic lesion............	Impression-degeneration of sciatic nerve below popliteal space; massage and electricity and wait 2 months
	All left thigh.................	0.00033	70	Very active	Normal	None	
7/26/20	All of left leg................	0.009	105	Weak	None	Same	No massage or electricity for 2 weeks, therefore much edema; faradism negative
8/26/20	Left tibialis anticus, peroneus	{0.0008 sure {0.0006 doubtful	75	Weak	None	Smaller but of same shape as on 6/23	Prognosis given, good and no operation advised; faradism negative
	Gastrocnemius and soleus...	0.0008	75	Weak	None		
9/18/20	All of left leg................	{0.00033 {0.009	100 40	Fair	Very slight if any	Sole of foot and about 1½ inches up on foot all around	Few trophic ulcers; faradism negative
11/17/20	All of left leg................	0.00015	90	Fair	Contraction of muscles but ankylosis prevents movements	Over all of toes and distal half of sole	Faradism negative (cyanosis of leg below knee after baking); patient could not stand strong enough faradism to cause contractions
2/ 2/21	All of left leg................	0.00015	90	Good	Good contractions	Over all of toes with blisters and cyanosis	Faradism positive

Summary: Muscle complex changed to the longest nerve-muscle complex in 2 months after first examination and this shortened to normal in 3 months; area of anesthesia became smaller parallel to decrease in duration of current but both showed regeneration from 1 to 2 months before voluntary contractions. When patient was first seen a complete sciatic paralysis was diagnosed, but the prognosis was withheld for 2 months (5 months after injury) to allow regenerating fibers (if present) to reach the muscles and skin of the leg. At the end of this time the anesthesia had decreased and duration of current showed a long nerve-muscle complex; therefore a good prognosis was given without an exploratory operation. This prognosis was followed by loss of anesthesia, normal nerve-muscle complex and voluntary contractions 3 months later at which time the patient could not stand a strong enough faradic current to cause contractions (gain over faradism of at least 3 months, over voluntary movements at least 23 days). On September 18 response to 0.00033 second at 100 V and 0.009 second at 40 V. 40 V = 2 × rheobasic voltage.

Case 5.—P. G., poliomyelitis of one and one half years' duration; baking and massage past six months; right leg, poor flexion of foot, slight extension of big toe, poor extension of thigh, inversion and eversion of foot gone, flexion of knee gone.

TABLE 8.—Findings in Case 5

Dates of Examinations	Motor Points Tested	Duration of Current in Seconds	Approximate Strength of Current in Volts	Type of Contractions	Voluntary Contractions
6/26/20	Gluteus maximus	0.00065	95	Fair	?
	Biceps femoris long head	0.009	95	Fair	No
	Semitendinous	0.009	95	Fair	No
	Semimembranous	0.009	95	Fair	No
	Gastrocnemius	0.0008	95	Fair	No
	Soleus	0.0008	95	Fair	No
	Vastus lateralis	0.00015-33	95	Fair	Yes
	Vastus medialis	0.00015-33	95	Fair	Yes
	Rectus femoris	0.00015-33	95	Fair	Yes
	Tibialis anticus	0.009	95	Fair	No
	Extensor hallicus longus	0.009	95	Fair	No
	Peronei	0.0008	95	Fair	Slight
8/ 3/20	Gluteus maximus	0.00015	95	Fair	Slight
	Biceps femoris	0.00015	95	Fair	Slight
	Semimembranous	0.00015	95	Fair	Slight
	Semitendenous	0.00015	95	Fair	Slight
	All others as on 6/26				

Summary: The muscle and slow nerve-muscle complexes explain the losses or impaired function of various muscles; by referring back to the origin of the nerves supplying the affected muscles the lesion is in L 4 and 5, S 1, 2 and 3 segments of the cord; muscles of thigh changed from muscle to rapid nerve-muscle complexes as slight voluntary movements returned.

Case 6.—F., Bell's palsy left—onset July 30.

TABLE 9.—Findings in Case 6

Dates of Examinations	Motor Points Tested	Duration of Current in Seconds	Approximate Strength of Current in Volts	Type of Contraction	Voluntary Contractions	Remarks*
8/ 2/20	All of right and left facial	0.00015	50	Good	None on left	Faradism present
8/ 4/20	All of left facial	0.00015	50	Good	None on left	Faradism present
8/ 9/20	All of left facial	0.00015	50	Good	None on left	Faradism present
8/25/20	All of left facial	0.00015	50	Good	Slight	Faradism present
10/15/20	All of left facial	0.00015	50	Good	Good	Faradism present

Summary: Paralysis came on over night, nerve-muscle response to both chronomyometer and faradic tests at all times but voluntary movement did not return for over three weeks. Good prognosis given on first examination. Voluntary contractions returned slightly in three weeks, definitely in six weeks.

Case 7.—M. W., left facial paralysis, complete, following suppurative parotiditis and open drainage Nov. 4, 1920. Paralysis first noted December 7.

Case 8.—R. T., left facial paralysis, onset July 2, 1920.

Case 9.—H. R., right facial paralysis; onset sudden, July 15, 1920; examined July 24, 1920; slight voluntary power in orbicularis oculi only; nerve-muscle response 0.00015 second with good contractions over entire right and left face; given good prognosis for early recovery possibly within two weeks. Aug. 3, 1920, (ten days later) a letter from the patient stated that he had the normal use of all muscles of the face. He was not tested with faradism which test no doubt would have been positive.

TABLE 10.—Findings in Case 7

Dates of Examinations	Motor Points Tested	Duration of Current in Seconds	Approximate Strength of Current in Volts	Type of Contraction	Voluntary Contractions	Remarks
1/ 5/21	All of left facial:					
	Upper branch..	0.009	90	Weak	None	
	Mid branch................	0.0008 0.009	90 30	Weak	None	
	Inferior branch...........	0.00015	30	Fair	Partial	
1/18/21	Upper branch..............	0.009	30	Weak	None	Patient massaging own face
	Mid branch................	0.0008	90	Weak	None	
	Inferior branch...........	0.00015	30	Fair	Partial	
2/ 2/21	Upper branch..............	....	..	......	None	Patient massaging own face
	Mid branch................	....	..	......	Slight	
	Inferior branch...........	....	..	......	Fair	
2/28/21	Upper branch..............	0.0008	80	Weak	None	Patient massaging own face
	Mid branch................	0.00033	80	Weak	Fair	
	Inferior branch...........	0.00015	30	Weak	Good	
4/15/21	Upper branch..............	0.00025	50	Weak	Slight	Patient massaging own face
	Mid branch................	0.00011	30	Good	Fair	
	Inferior branch...........	0.00011	30	Good	Good	

Summary: Seen four weeks after paralysis noted; very slight voluntary control of muscles innervated by inferior branch. Good prognosis given on basis of good nerve-muscle complex in inferior branch and slow in mid branch, two weeks later some muscles in superior branch showed nerve muscle complex and two weeks after this the patient had some voluntary control of muscles innervated by lower two branches. Two months later there was rapid nerve muscle complex in all three branches and voluntary control in all three branches, though that in the superior branch was slight.

TABLE 11.—Findings in Case 8

Dates of Examinations	Motor Points Tested	Duration of Current in Seconds	Approximate Strength of Current in Volts	Type of Contraction	Voluntary Contractions	Anesthesia to Pin-Prick	Remarks
7/23/20	All of left facial	0.009	20	Fair	Negative	None	Faradism negative
8/10/20	All of left facial	0.009	20	Fair	Negative	None	Faradism negative
8/28/20	All of left facial	0.0008	55	Fair	Negative	None	Faradism negative
9/20/20	All of left facial	0.00015	15	Fair	Very doubtful	None	Faradism positive; slight wrinkles left side of face
10/23/20	All of left facial	0.00015	15	Good	Present but weak	None	Faradism positive
11/15/20	....	... ...	..	......	Practically normal		

Summary: Patient seen three weeks after paralysis, etiology unknown but possibility of severed nerve trunk very remote; operation not warranted though no nerve-muscle complex present. Prognosis withheld until August 28, two months from onset, when beginning nerve-muscle complex developed, yet faradism negative. Faradism positive one month later when doubtful voluntary contractions were present and wrinkles of skin began to return. Gain over faradism one month, over voluntary contractions at least twenty-three days.

Summary: This case illustrates that normal nerve-muscle complex was present even when the muscles did not contract voluntarily and recovery was rapid.

Case 10.—V. H., there was right facial paralysis in April, 1920, following a mastoid operation. Examination was made Oct. 21, 1920; paresis of middle and inferior branches and complete paralysis of superior branch; nerve-muscle complex of inferior and middle branches, 0.00015 second, superior branch 0.009 second with 50 volts and 0.008 with 70 volts; faradism positive in inferior and middle branches, but negative in the superior. Jan. 29, 1921, the patient's letter stated that he had good voluntary movement over the middle and inferior branches, but slight in superior branches.

Summary: Because of beginning nerve-muscle complex with 70 volts, we felt entire nerve would recover, and the later report seems to indicate that it is occurring.

Case 11.—H., partial left facial paralysis following brain abscess of left temporal lobe on Dec. 1, 1920. Paralysis noted Jan. 8, 1921. Examined Jan. 13, 1921. Only slight voluntary control of upper branch; no voluntary control of the two lower branches; good reaction in all the branches with 0.00015 at 10 volts; Jan. 8, 1921, good voluntary control of all branches.

Summary: Rapid nerve-muscle complex was present at height of paralysis, so that good prognosis was given and complete recovery followed in a week.

Case 12.—G. B., general polyneuritis (?), examined Nov. 20, 1920; all voluntary movements of left leg and ankle gone and only slight movement of third toe. Anterior and posterior groups of muscles of the left leg reacted only at 0.009 second with 80 volts. Right leg, movements of ankle and toes were slightly present and muscles reacted to 0.00033 second with 95 volts. No contractions elicited in either leg with faradic or galvanic current because the hyperalgesia made it too painful to use a strong enough current to bring out a reaction with either current. Burning sensation which patient could stand comfortably was present with the chronomyometer tests.

Summary: The chronomyometer reactions corresponded to the paralysis or paresis present. This case illustrates that electrical tests may be made on a patient with the chronomyometer when it is not possible to test the patient by ordinary methods because they are too painful.

Case 13.—E. K., median and ulnar secondary suture; extensor digitorum communis, 0.00015 second and good voluntary power; extensor carpi ulnaris 0.00033 second and poor voluntary power; other muscles of the forearm were normal. Ten months later, 0.00015 second in all muscles of the forearm and hand at 25 volts except lumbricales, which required 95 volts and good voluntary power in all muscles except the lumbricales.

Summary: This case illustrates the increase in voluntary power paralleled by shortening of the nerve-muscle complex.

Case 14.—A. W. G., gunshot wound through the lumbar region. Current strength 65 volts, right leg: obturator nerve, 0.00033 second; femoral nerve, 0.00015 second; biceps muscle, 0.00033 second; tibial nerve, 0.00033 second; peroneal nerve, no response; tibialis anticus muscle, 0.009 second; peroneii, 0.009 second; soleus, 0.00015 second; gastrocnemius, 0.00015 second. Left leg: sciatic nerve, 0.00015 second; peroneal nerve, negative; tibial nerve, 0.00015 second; biceps femoris, 0.00015 second; tibialis anticus, 0.0008 second; peroneii, 0.0008 second.

Summary: Examination revealed a bilateral injury to the sacral plexus affecting the roots which supply primarily the peroneal nerves, especially on the right side.

Case 15.—A. G., median and partial ulnar in axilla; repaired two years ago. Examined June 30, 1920. All motor points 0.00015 second with 70 volts and limited function, but sensory regeneration practically normal; on Feb. 20, 1921, practically normal function.

Summary: Rapid nerve-muscle complex indicated that problem of regaining function was one of reeducation which was confirmed by observation eight months later.

Case 16.—D. L. R., ulnar injury above the wrist six years ago; repaired March, 1920; tested July 9, 1920; some sensations in little finger. There was marked atrophy of muscles of hand, therefore electrical testing was difficult. Reaction to 0.0008 second and doubtful voluntary movements of ulnar muscles.

Case 17.—M. R., examined July 20, 1920; reduced congenital dislocated hip with sciatic nerve injury left; reduced three years ago, in cast three months, anesthesia from knee down, weak movements of knee and paralysis of foot when cast was removed. Reaction of gluteals, 0.00015 second; upper thigh, 0.00033; lower thigh, 0.00065; below the knee, 0.0008 second posteriorly, and 0.009 anteriorly. Right leg showed normal reaction. March 19, 1921: All of left thigh, 0.00015 second, soleus and gastrocnemius, 0.0008 second, tibialis anticus and peroneii, 0.009 second with poor reaction, plantaris longus, 0.009 second. Anesthesia to pin prick below ankle, but deep sensation present down to tips of toes. Voluntary Movements: Thigh good, knee fair, ankle only slight extension, foot inverted with toe drop.

Summary: In eight months nerve-muscle complex of thigh shortened, and parellel with this the voluntary power increased; no signs of improvement below the knee except a decrease in the anesthesia and a slight extension of the ankle which shows that the slow nerve-muscle complex means some innervation.

Case 18.—S., spastic paraplegia from a spinal cord cyst. Reaction of all motor points of both legs, 0.00015 second with 20 volts.

Summary: This case shows that the paralysis due to injury of the upper neuron did not alter the electrical reactions of the lower neuron.

Case 19.—J. B., back injured July 20, 1920. Tested Sept. 10, 1920. Paraplegia from the level of iliac spines down, with anesthesia to touch, and only the muscle complex 0.009 with 100 volts.

Summary: Complete degeneration of the lower cord and peripheral nerves.

Case 20.—R. K., amyotonia congenitalis (?). No nerve-muscle or muscle response in either leg except in the rectus femoris right (0.00015 second, good response); sartorius right (0.00015 second, fair response) vastus externus, right (0.0008 second, weak response). Voluntary movements only in rectus femoris and sartorius. No anesthesia or trophic changes. Legs about half normal size, but had appearance of having normal sized muscle for that sized leg.

Summary: The electrical response was parellel to voluntary movements and showed a degeneration of the motor nerves and their muscles.

Case 21.—M., lower spinal injury followed immediately by operation; complete paralysis of both legs since accident one and one-half years ago; marked atrophy of muscles of both legs; no voluntary movements; trophic ulcers and limitation of motion of joints of both legs, no muscle or nerve-muscle response in either leg; anesthesia up to mid-thigh. The patient showed complete loss of irritable nerves or muscles eighteen months after injury.

DISCUSSION

Previous workers who have studied regeneration of nerves by observations on the chronaxie have hoped to find a method by which at a single examination it could be determined that the process of regeneration was going on. In consequence Adrian [14] has arrived at the conclusion that though chronaxie is of great physiologic interest, it has no practical value. Thus he says "The presence or absence of excitable nerve fibers can be detected well enough by the ordinary faradic coil and except for purposes of research there is little to be gained by the use of condensers or any other more elaborate method." In Lapicque's [13] published papers he has observed that chronaxie lengthens as degeneration progresses, but we find no statement indicating that he ever studied chronaxie changes in regenerating nerves. Furthermore, in all his studies he seems to disregard the variation in the strength of the current necessary to bring out chronaxie.

In the work recorded in this paper repeated observations were made with the chronomyometer during the regeneration and degeneration of nerves. Thus it has been possible to show that the nerve-muscle complex becomes shorter during the period of regeneration and that it lengthens during the degeneration of a nerve.

The only instance of repeated observations of chronaxie that we have been able to find any record of is a single case of Adrian's [14] on a facial paralysis in which he made observations on the orbicularis oculi and observed a gradual shortening of the chronaxie from 0.0075 second to 0.0003 second. In other words, the chronaxie shortened about twenty times, yet Adrian does not seem to consider this observation at all significant. Possibly this was due to the fact that voluntary movement was present when the chronaxie was 0.0075 second. In our own observations we have shown that far more important than chronaxie are the changes in the minimum duration of the current in so far as it brings out the progressive shortening of the nerve-muscle complex that occurs when a nerve regenerates.

It is, of course, apparent that until a regenerating nerve has reached a muscle one cannot hope to detect any changes in the minimum duration of the current. Thus the time between the appearance of the muscle complex following a nerve injury and the reappearance of the nerve-muscle complex will vary with the distance between the site of the nerve injury and the nearest muscle to be innervated by the nerve under consideration. When a nerve injury case is seen early (after about three weeks) it is of great value to know whether only the muscle complex is present, for this would indicate that the nerve has completely degenerated; following this, however, no observations on minimum duration are of value until the nerve has reached the nearest muscle. When a nerve, therefore, has a great distance to grow, which would mean months before one could hope to get any evidence of beginning regeneration, an early exploration seems desirable, but if the nerve has only a short distance to grow to the nearest muscle, exploration might well be deferred until the average time for regeneration has elapsed (about 1 cm. a week). Where the principal disability is due to atrophy of small muscles, as in an ulnar or musculospiral paralysis, it may be unwise to defer operation.

If at exploration the nature of the lesion is still uncertain, another method suggested by one of us (J. Y. M.) of determining whether the axis cylinders have grown through the lesion may be employed. This subject was discussed in another paper which appeared in the November issue of *Archives of Surgery*.

SUMMARY AND CONCLUSIONS

The following points seem to us to be the most important ones derived from this study:

1. The chronomyometer is a practical instrument for detecting regeneration of nerves in clinical cases.

2. The determination of the minimum duration of a current necessary to stimulate a muscle is of greater value than determining the chronaxie.

3. The nerve-muscle complex after a nerve has been cut has always disappeared in animals within seventy-six hours and in one human case by the fifth day.

4. As regeneration occurs the nerve-muscle complex shortens gradually. This has been demonstrated both in animal experiments and clinical cases.

5. The nerve-muscle complex begins to appear from one to six months before faradic response, from one week to three months before voluntary contractions and from zero to five months before contraction of the area of anesthesia.

6. The variation in the minimum duration of the current necessary to stimulate muscles along the distribution of a nerve as well as repeated tests of one muscle may be of value in determining the regeneration of a nerve.

7. The faradic response of muscles and voluntary movements do not return until the nerve-muscle complex has reached normal limits.

8. Chronomyometer tests are of value as soon as a nerve has degenerated (five days or less) and as soon as regenerating fibers have reached the nearest muscle. This time can be estimated with fair accuracy by measuring the distance between the lesion and the nearest motor point.

9. The method herein described offers a more accurate means of determining much earlier the progress of nerve regeneration. Combined with a study of sensory changes, trophic disturbances, etc., it is a distinct aid in the prognosis and treatment of nerve injuries.

DISCUSSION

Dr. Sanger Brown of Kenilworth said that in the early eighties of the last century it was rather enthusiastically taught in some quarters that electricity might be used in paralysis due to a nerve lesion to hasten recovery. and no doubt at the present time it is quite extensively used for this purpose. Since these reported investigations seem to have been carried out with such exceptional thoroughness, he would like to ask whether the writers of the paper had any suggestions to offer on this point. He also asked whether the methods employed in testing would have any injurious effect on nerve lesion at any stage, because no matter how absurd such a question might appear, it was likely to be raised in medicolegal cases, where such tests were used.

Dr. M. Allen Starr of New York thought that the value of Dr. Sachs' paper could not be emphasized too greatly, because it had a medicolegal application. He said that occasionally he was asked to decide cases before the New York State Commission for Compensation for Injuries, and he recalled a case seen recently in which this would have decided definitely whether the man was going to recover from a serious brachial palsy or whether he was permanently disabled.

Dr. Isador Abrahamson, New York, asked whether Dr. Sachs, with his newer method of examination had studied its relationship to the incidence of such sequelae of facial palsy as contracture and hemispasms.

Dr. Ernest Sachs of St. Louis, in closing, said regarding the therapeutic effect, that this method had been of distinct value. A woman, who had a gash across her face, with complete facial paralysis, went to see him. The question was whether or not the facial nerves had been cut. Heretofore the only method of determining this was to wait and see whether the nerves would recover. By testing with this method, however, they found that the long nerve muscle complex was present. She was given a good prognosis, and in four months began to move her face.

They have tested now about thirty-five clinical cases of all sorts, and they have found that when the first evidence of the nerve muscle complex appearing is obtained, a complete regeneration of the nerve is certain.

Regarding Dr. Abrahamson's question about facial spasm, Dr. Sachs said they had had no experience with this condition.

THERAPY IN NEUROSYPHILIS, WITH PARTICULAR REFERENCE TO INTRASPINAL THERAPY *

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AND
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The pressing need of more effective therapy in neurosyphilis has stimulated syphilographers and neurologists to elaborate methods expressly adapted to combat the disease. These methods may be roughly divided into: (1) intensive antisyphilitic medication, including arsphenamin given intravenously, mercury and the iodids; (2) drainage of the spinal fluid, following a previous intravenous injection of arsphenamin; (3) the intraspinal methods of Swift and Ellis, Ogilvie and Byrnes. Each of these methods has produced good clinical results in the hands of competent observers, but each has certain inherent defects. Sachs [1] and his co-workers feel strongly that intravenous treatments will clear up such cases as are amenable to medication. Dercum [2] has obtained favorable results from complete drainage of the spinal fluid. Swift,[3] Ogilvie, Byrnes and Fordyce report good results following intraspinal procedures. Other than an inclination to advise intraspinal medication in difficult cases, there has been little tendency in the literature on the subject to indicate the type of therapy most likely to benefit a particular case.

That such individualizing, if it could be accomplished, would be of marked benefit is quite obvious. The intensive methods are the simpler, they require no specialized technic and therefore can be used more generally by the profession. They are less distressing and time-consuming to the patient.

Drainage is next in point of simplicity and presents no drawback, except lumbar puncture headaches and the inconvenience of the punc-

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* Read at the Forty-Seventh Annual Meeting of the American Neurological Association, Atlantic City, June, 1921, by Dr. H. G. Mehrtens.

[1] Sachs, B.: The Truths About Intraspinal Treatment. J. A. M. A. **69**:681 (Sept. 1) 1917.

[2] Dercum, F. X.: Functions of Cerebrospinal Fluid with Special Consideration of Spinal Drainage and of Intraspinal Injections of Arsphenamized Serum, Arch. Neurol. & Psychiat. **3**:230 (March) 1920.

[3] Swift, Homer F.: Intraspinal Treatment of Syphilis of the Central Nervous System, J. A. M. A. **69**:2092 (Dec. 22) 1917.

ture. The intraspinal methods require a rigid technic, more time and apparatus and are more distressing to the patient. The patient's interests are best subserved when these methods are applied only when simpler methods are unavailing.

PATHOLOGIC LESIONS FROM THE STANDPOINT OF THERAPY.

We may now consider the various pathologic lesions, grouped under the caption of neurosyphilis, from the standpoint of therapy. For our purposes the classification of Southard and Solomon[4] is especially useful. They note these types: meningeal, vascular, parenchymatous, meningovascular and diffuse (meningo-vasculo-parenchymatous). Of these divisions, the vascular and meningovascular types would seem to be best treated by way of the blood stream.

The therapy of epidemic cerebrospinal meningitis demonstrated that certain meningeal lesions are most effectively combated by allowing the therapeutic agent direct access to the lesion by way of the subarachnoid space.

It seems improbable, even on theoretic grounds, that intraspinal treatment is indicated in every case of meningeal syphilis, for it has been repeatedly shown that arsenic injected intravenously appears in the spinal fluid in from 25 to 40 per cent. of the cases treated. Whether or not one is inclined to place much emphasis on the importance of the presence of arsenic in the spinal fluid, it would seem at least to indicate good permeability in the minority of cases. These patients should do well on intensive therapy alone.

Complete spinal fluid drainage has established itself as a valuable therapeutic measure in tuberculous as well as epidemic meningitis. Dercum believes that the good results obtained in neurosyphilis may be explained on a basis of a reduction of increased intradural pressure, a lavage of the dural spaces, and a relative vascularity of the meninges and cord with consequent improved nutrition.

EFFECT OF INTRASPINAL THERAPY ON MENINGES

Flexner and Amoss,[5] in their work on poliomyelitis, demonstrated a let-down in the barriers between the blood and spinal fluid. This let-down could be produced by a variety of irritants, ranging from the intraspinal injection of blood serum to lumbar puncture. They felt that the permeability of the meninges was dependent on the irritation.

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[4] Southard and Solomon: Neurosyphilis, Case History Series, Boston, W. M. Leonard.

[5] Flexner, S. and Amoss, H. L.: Neutralizing Substances in Poliomyelitis, J. Exper. Med. **25**:499 (April) 1917.

Continuing along these lines, one[6] of us undertook some experiments to determine the natural permeability of the meninges to antisyphilitic medication. It was found that arsenic could be detected in the spinal fluid in 42 per cent. of patients receiving intravenous injections of arsphenamin. This was a slightly higher percentage than was found by Solomon and Rieger.[7]

The meninges were then irritated by the patient's own serum, as must normally occur when an intraspinal injection is given. This irritation showed itself in a spinal fluid pleocytosis of from 100 to 2,300 cells per cubic millimeter. The arsenic estimated was found in exceedingly small amounts, averaging 0.036 mg. per cubic centimeter in the unirritated cases and 0.1 mg. per cubic centimeter in the irritated ones. It has been objected that the amount of arsenic found in either case was too small for accurate estimation, and might well be within the limits of error of the chemical methods employed; therefore, at the present time we are still unable to state definitely that Flexner's ideas concerning the therapeutic value of irritation can be applied clinically to man.

We can feel certain that intraspinal therapy produces meningeal irritation of a most intense character; that the hyperemia of the meninges and exudation of the serum following this irritation is more intense than that obtained by any other means commonly employed.

CLINICAL RESULTS

Turning now to the clinical results, let us determine when possible, how far these theoretic considerations are supported by the facts observed here. Our material consists of 208 cases of neurosyphilis treated by intraspinal medication since 1915. Seventy-five patients were given thorough treatment, receiving from six to eighteen intraspinal injections. During that time 1,500 intraspinal injections were given. This material is unusual in that, previous to that time, all neurosyphilitic patients in the Stanford Clinics were treated by the intravenous and intramuscular methods. We therefore had the opportunity of estimating the results from this form of therapy without the addition of other procedures.

Ignorance of the language, inability to understand the importance of continuing treatment, combined with financial difficulties, resulted in many incompletely treated cases in our clinical material.

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[6] Mehrtens, H. G., and MacArthur, C. G.: Therapy of Neurosyphilis Judged by Arsenic Penetration of the Meninges, Arch. Neurol. & Psychiat. **2**:369 (Oct.) 1919.

[7] Solomon, H. C., and Rieger, J. B.: Circulation of Arsenic in the Cerebrospinal Fluid, J. A. M. A. **71**:15 (July 6) 1918.

INTRAVENOUS AND INTRAMUSCULAR THERAPY

In considering the results in patients treated with intravenous and intramuscular therapy, it must be noted that a few of the treatments extended over the whole year and, therefore, the patients did not receive treatment in quite so intensive a form as patients with intraspinal cases.

Some clinical improvement was obtained in the majority of cases. Serologically only 19 per cent. cleared up entirely, that is, the Wassermann reaction was negative in all dilutions, the globulin normal and the cell count three or less. Of these, one patient became positive again serologically in a few months. The vascular and meningovascular lesions were more amenable to therapy, as judged by both symptomatic and serologic improvement. The parenchymatous lesions showed no improvement either clinically or serologically.

TABLE 1.—Cases Treated with Intravenous and Intramuscular Therapy

		Clinical Results-				Serologic Results					
		Improved		Not Improved		Clear		Improved		Not Improved	
Diagnosis	Number of Cases	Number	Per Cent.	Number	Per Cent.	Number	Per Cent.	Number	Per Cent.	Number	Per Cent.
Tabes	14	12	85	2	15	2	14	10	71	2	14
Cerebrospinal syphilis	11	11	100	0	..	3	27	8	73	0	
Paresis	1	0	...	1	..	0	..	0	..	1	..
Totals	26	23	88	3	12	5	19	18	69	3	12

DRAINAGE THERAPY

Intravenous medication plus drainage was used in thirty-six cases (from four to ten drainages). Unfortunately this form of therapy was combined with intraspinal medication in most cases, making conclusions unreliable. The change to the Swift-Ellis and Byrnes methods was frequently made at the request of the patients, who, as a rule, seemed to prefer the intraspinal methods, or improvement seemed so slow that the staff felt that the patient should receive the most vigorous treatment possible. Our impressions of the results thus obtained from drainage were: Symptoms dependent on spinal fluid pressure, such as headaches and other complaints which could be traced to intercranial pressure, were ameliorated. The serologic improvement was considerably better than that which followed simple intravenous medication. In brief, we felt that drainage is definitely more effective than intravenous or intramuscular therapy alone. There were cases, however, which seemed resistant to drainage but which yielded to intraspinal therapy.

RESULTS OF INTRASPINAL THERAPY

The intraspinal therapy used consisted of the Swift-Ellis, Byrnes and Ogilvie methods and the modifications suggested by one [6] of us. Table 2 shows that every case of cerebrospinal syphilis improved symptomatically; 75 per cent. became negative serologically. The tabetic patients, as a whole, did less well, but symptomatically 55 per cent. improved and more than 40 per cent. became clear serologically.

Patients with optic atrophies, generally far advanced before treatment began, showed no improvement. Patients with tabes without positive findings in the spinal fluid experienced little relief symptomatically. The lightning pains, crises and other symptoms continued as previously. If these two unfortunate types be omitted, 80 per cent. were improved symptomatically and 56 per cent. became clear serologically.

TABLE 2.—Cases Treated with Intraspinal Therapy

		Clinical Results				Serologic Results					
		Improved		Not Improved		Clear		Improved		Not Improved	
Diagnosis	Number of Cases	Number	Per Cent.	Number	Per Cent.	Number	Per Cent.	Number	Per Cent.	Number	Per Cent.
Tabes	25	20	80	5	20	14	56	5	20	6	24
Optic atrophy	6	0	..	6	100	3	50	..	..	3	50
Arrested tabes	11	3	27	8	73	11	100				
Total tabes	42	23	55	19	45	28	66	5	11	9	21
Cerebrospinal syphilis	21	21	100	0	..	16	75	2	9	3	14
Paresis	12	4	33	8	67	3	25	3	25	6	50
Total cases	75	48	64	27	36	47	63	10	13	18	24

Five patients were given intraspinal treatment when ten or more intravenous injections of arsphenamin plus intramuscular mercury salicylate had previously failed to render the spinal fluid normal. Of these, three tabetic patients became entirely clear after four, six and seven further intraspinal injections, and remained clear. One of these cases had previously been drained five times in addition to the intraspinal treatment, and still showed a positive Wassermann and a pleocytosis. One case (tabetic) with optic atrophy showed a negative spinal fluid after six additional intraspinal injections. No clinical improvement was obtained. One patient with taboparesis showed no clinical or serologic improvement after eight additional intraspinal treatments. The results obtained in this rather small group would suggest that intraspinal therapy is the most potent means we now have of securing a normal spinal fluid. It also has its limitations.

Patients with paresis, as a whole, did poorly. Three cases so diagnosed clinically and serologically, cleared up entirely; the patients went back to work and have remained serologically clear for four, nine and twelve months, respectively. Possibly only a remission was secured, but the fact remains that improvement did occur after treatment. At any rate, these cases emphasize the importance of treatment when there is any doubt about the diagnosis.

Disadvantages of Intraspinal Treatment.—The disadvantages of intraspinal methods may be divided into the discomforts incident to the method, pain, fever, occasionally nausea and difficulty in passing urine for twenty-four hours. That none of these features are of serious importance to the patient is demonstrated by the efforts of the patients to continue treatment in spite of many physical and financial handicaps. Patients requested intraspinal treatments who previously had been treated intravenously or by drainage.

The complications in 1,500 treatments were:

In one case in which the Byrnes treatment was used, the intern ran the mercuric chlorid up to $\frac{1}{25}$ of a grain. (Our custom is never to use more than $\frac{1}{50}$ of a grain.) The result was bladder incontinence which has not improved in two years. One patient with paresis died suddenly of apoplexy following preliminary intravenous injection of arsphenamin. One patient with tabes died immediately following the intravenous injection of arsphenamin given before the intraspinal treatment. Two tabetic patients previously treated with six and eight intraspinal injections, respectively, still had positive findings in the spinal fluid. They were both given the usual preliminary arsphenamin injection intravenously. Either because of the peculiarity of the drug or the way it was mixed both patients developed respiratory distress and pulmonary edema, followed in three and four days, respectively, by chest signs of pneumonia and fever. After recovery from these complications, intraspinal therapy was resumed. One patient was found to possess a normal spinal fluid, the other case became normal following one more intraspinal injection.

These complications emphasized the fact previously brought out, particularly in relation to paresis, that intercurrent infections tend to influence favorably the course of neurosyphilis. It even seemed possible that the fever, which almost invariably occurred following intraspinal injections, might itself be responsible for some of the good therapeutic results.

Thus our experience with 1,500 treatments has been as free from complications as a corresponding number of intravenous injections of arsphenamin alone.

During the course of intraspinal treatments it occasionally became impossible to give intravenous injections because of thrombosis of the veins. In order to get the arsphenamin into the circulation in these cases, one[8] of us used massive doses of neo-arsphenamin (4 gm.)

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[8] Mehrtens, Henry G.: Rectal Injection of Massive Doses of Neo-Arsphenamin, J. A. M. A. **76**:574 (Feb. 26) 1921.

injected rectally. In over 300 rectal injections there were no disagreeable sequelae, except in one patient who had developed a very severe case of exfoliative dermatitis. This condition had previously occurred in a milder form in the same patient, following an intravenous injection.

Following these massive rectal injections of neo-arsphenamin, arsenic was found in the spinal fluid in about the same concentration as after an injection of 0.6 gm. of arsphenamin injected intravenously.

In sixteen cases we were forced to substitute the rectal for the intravenous injection of arsphenamin in intraspinal treatments. The results are not ready for final evaluation but are sufficiently encouraging to warrant the use of rectal injection of arsphenamin when the intravenous route is impracticable.

CONCLUSIONS

Intravenous and intramuscular therapy caused symptomatic improvement in the majority of cases. Serologically only 19 per cent. cleared up entirely. It was more efficacious in the meningeal, vasculo-meningeal and diffuse types.

Drainage, in addition to the foregoing results, impressed us as a definite advance both in ability to ameliorate symptoms and in tendency to improve the spinal fluid pathology.

Intraspinal medication was superior to the intravenous and intramuscular methods in its effectiveness in clearing up the spinal fluid. Forty-eight per cent. of the cases became clear through the use of the intraspinal methods as compared to 19 per cent. following the intravenous method.

The most useful field for intraspinal therapy is that of the meningo-parenchymatous types, including tabes. However, patients with optic atrophy and with tabes without meningeal reaction received no benefit. Patients with parenchymatous lesions (including paresis) did poorly, but 25 per cent. of the cases thus treated cleared up clinically and serologically. A remission, at least, was effected.

In our experience complications in intraspinal therapy are no more frequently met with than in intravenous medication.

Massive rectal injections of neo-arsphenamin (4 gm.) may be profitably substituted for arsphenamin given intravenously in intradural medication when intravenous injection is impracticable.

In the treatment of the individual case of neurosyphilis, it would therefore seem proper to begin with intensive intravenous and intramuscular medication, particularly in vascular, meningovascular and diffuse lesions. Failure to reduce spinal fluid findings to negative after a thorough trial should suggest the advisability of using more intensive methods. Drainage, combined with intravenous injections, again should be the procedure of choice when the facilities for more complicated methods are lacking or when symptoms of increased spinal fluid pressure are distressing. The Swift-Ellis, Ogilvie or Byrnes method should be reserved for cases resistant to the foregoing efforts. These resistant cases will be found particularly in tabetic patients. Patients with optic atrophy and neurosyphilis without cerebrospinal fluid reaction receive no advantage from intraspinal medication. This was anticipated by one [9] of us in a pathologic study of such cases. Paretic patients should be given a trial. Patients with inadequate veins can profitably receive the arsenic in the form of massive rectal injections of neo-arsphenamin.

DISCUSSION

Dr. Walter F. Schaller of San Francisco thought that the interest in intraspinal therapy had been quite general. There had been a difference of opinion as to the efficacy of this method of treatment, indeed whether such treatment should be given at all. The objections, as far as he had been able to follow in the literature, had been a general expression of opinion rather than a comparison of groups of neurosyphilitic cases, treated intensively on the one hand by intravenous therapy and on the other by intraspinal therapy. The object of the paper was to present such a comparison for consideration. It was his opinion, based on this study, that the greatest field of usefulness of intraspinal therapy was in refractory cases which did not improve under the intensive intravenous and other specific medication, and especially in meningeal forms and early meningoparenchymatous forms of neurosyphilis. A number of patients treated intensively in the dermatologic clinic and developing nervous symptoms showed on cerebrospinal analysis positive fluids. These fluids were cleared serologically and the patients relieved symptomatically by intraspinal therapy. Conversely, patients with evident neurosyphilis with negative serology were not improved by intraspinal treatment. On theoretic consideration the latter result was anticipated a few years ago, which Dr. Schaller thought had been borne out by practice.

Dr. Israel Strauss of New York said that this paper interested him very much because he thought it was probably the first one written by a neurologist on this subject, after careful study and investigation. Most of the papers written on intraspinal therapy had been given by dermatologists and others who had not been competent to judge the results of the treatment because of their ignorance of the symptoms, and particularly of the course of neurosyphilis. This was the first paper which Dr. Strauss had ever heard on intraspinal medication, in which it was admitted that not merely was there discomfort but that there could be serious complications.

Furthermore, he was certain that the writers of this paper, although they did not quote the literature, knew there had been a number of cases in which death had followed the use of the method. Of course, this criticism applied to medicine in its general aspect because it is never known at what time a certain method or even a commonly used drug may find an individual who is susceptible and who suffers unusually from the therapeutic measure. Nevertheless, this treatment is fraught with considerable danger, even though the writers of this paper, outside of the few instances they cited, were fortunate enough in not obtaining serious results.

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[9] Schaller, W. F.: The Pathogenesis of Tabes Dorsalis, Arch. Neurol. & Psychiat. **1**:749 (June) 1919.

Dr. Schaller stated that he limited the use of this method to the so-called meningeal type of syphilis, which statement he qualified by saying tabes. In certain cases of tabes, intravenous treatment did not give the desired relief from clinical symptoms, and in a few cases favorable results were obtained with the intradural method. It required a great deal of care in order to pick out the cases in which this method should be resorted to.

Dr. Harry W. Mitchell of Warren, Pa., said that for the past ten years about fifty cases of neurosyphilis, mostly of the paretic type, had been admitted annually to the Warren Hospital where the various methods of treatment had been adopted and the result checked by clinical and serologic criteria. He had noted during that period a larger percentage of remissions than was formerly seen in untreated paretic patients, but he was obliged to report that a large number of these patients showing remissions had ultimately been returned to the hospital where their disease had terminated fatally. As a result of his experience with this condition he regarded any improvement, either serologic or clinical, as temporary rather than permanent. This observation applied to cases so far advanced as to require commitment to a hospital for the insane. Possibly serologic determination of the condition before it had advanced to the point at which clinical diagnosis was positive might be followed by early, vigorous treatment resulting in actual "cure." This question, however, could be settled, in his opinion, only by prolonged treatment and observation of many such early cases. Pending such determination he could see no justification in speaking of improvement in paresis as anything more than a remission, and he believed that the word "cure" was no more applicable to these cases than it would be in the primary stage of syphilis following a short course of antisyphilitic treatment.

He felt possibly the best results that could be obtained from recent methods of diagnosis and treatment of neurosyphilis would be the recognition of serologic evidence of the disease in immediate relatives and starting treatment that might prevent the hopeless conditions.

He desired to know whether the readers of the paper had reason to present any different conclusions regarding neurosyphilis of the paretic type.

Dr. Walter F. Schaller said that he could speak definitely of the ultimate course of only three patients with paresis who showed remissions after intraspinal therapy. These patients were cleared serologically as well as arrested symptomatically and remained so as long as observed, in one case after a period of one year.

THE SIGNIFICANCE OF BIOLOGIC REACTIONS IN SYPHILIS OF THE CENTRAL NERVOUS SYSTEM

WITH NOTES ON TREATMENT, ESPECIALLY INTRASPINAL *

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In a paper published in 1918, we[1] reported an intensive study of this subject in the neurologic wards and serologic laboratory of the Mount Sinai Hospital. We now desire to bring our experiences down to date and to express our present views. In the light of a tendency to overemphasize the importance of early spinal fluid reactions, we have deemed it expedient critically to review these reactions and to estimate their significance as regards changes in the nervous system, and their proper relation to the nature and intensity of treatment.

Our knowledge of cytodiagnosis of the cerebrospinal fluid began with the work of Widal, Ravaut and Sicard[2] in 1900. The addition of the Wassermann test, protein estimation and the colloidal gold test placed the diagnosis of syphilis of the central nervous system on a definite basis.

PRECLINICAL CHANGES IN SYPHILIS OF CENTRAL NERVOUS SYSTEM

Ravaut showed that during the primary and secondary stages of syphilis, there is in 68 per cent. of the cases, a latent nonsymptomatic meningitis, the only evidence of which is obtained by lumbar puncture. Dreyfus[3] found similar changes in almost 80 per cent. of the cases. These figures have been corroborated by numerous observers. Perhaps if puncture were performed often enough, such changes might be found in all early cases. The departure from the normal in the early stages consists principally of increase in the cell count, protein increase (albumin of globulin; phase 1 of Nonne), and occasionally, of the presence of the Wassermann reaction. These facts are incontrovertible; it is their interpretation and significance as indicating permanent or ephemeral change in the neuraxis that are in question.

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* From the Neurologic Service of the Mount Sinai Hospital, New York.

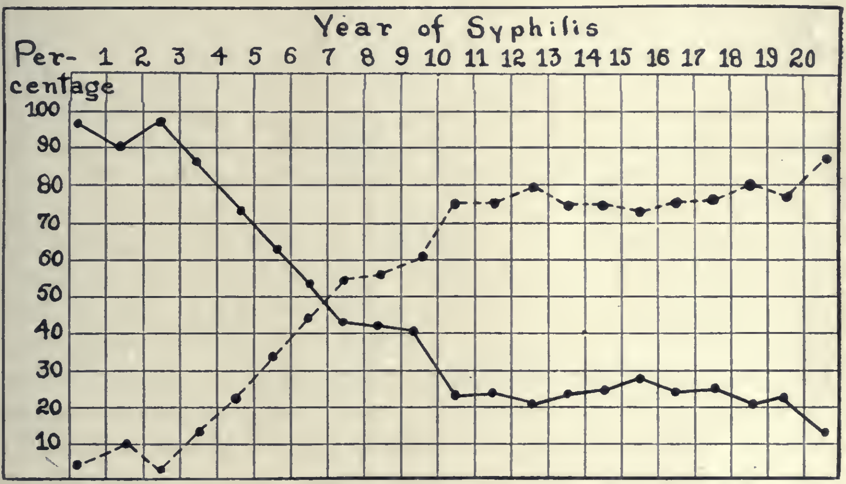
* Read before the Section on Nervous and Mental Diseases, at the Seventy-Second Annual Session of the American Medical Association, Boston, June, 1921.

[1] Kaliski, D. J., and Strauss, I.: On Syphilis of the Nervous System: Pathological, Serological and Clinical Criteria with Especial Reference to Treatment, Am. J. Syphilis **2**: No. 4, 1918.

[2] Widal, F.; Sicard, A., and Ravaut, P.: Bull. Soc. méd. d. hôp de Paris, **18**:31-34, 1901; Ann. de dermat. et syph. **4**:1-14, 1903; Thèse de Paris, 1899.

[3] Dreyfus, G. L.:Deutsch. med. Wchnschr. **45**:1293-1326, 1919; München med. Wchnschr. **66**:1374-1376, 1919.

According to Ravaut,[4] the early changes are transitory and of the nature of a septicemia, while those occurring later in the disease are definitely focal, usually of the nature of a meningovasculitis. These latent reactions are common up to the fourth year, as shown in the chart, diminishing from that time to the twelfth year, and remaining more or less stationary up to the twentieth year, when they again diminish. Persistence of the septicemic reaction after the third year is, in the opinion of Ravaut, evidence of involvement of the central nervous system, especially if all the reactions are positive (the number of cells, the globulin and Wassermann reaction). Thus, lumbar puncture should be practiced during the first three years following infection, and if not then, at least at some period between the fourth and the tenth years, because then the ephemeral septicemic reactions tend to disappear while the clinical symptoms both objective and subjective tend to increase steadily. The importance of lumbar puncture is stressed by Ravaut as affording the only means of determining the presence of the latent meningitic condition, thus enabling one to take measures to eradicate it. To obtain evidence of the presence of syphilis in nervous or psychic disorders, especially if the blood reactions are negative, it is imperative.



Relationship between biologic phenomena in spinal fluid and neurosyphilis (after Ravant).

Continuous line indicates presence of biologic changes in fluid and absence of clinical signs of neurosyphilis. Broken line indicates definite neurosyphilis accompanied by spinal fluid changes.

Since we lack precise knowledge of the morphologic changes in early syphilis of the central nervous system, numerous hypothetic explanations have been offered for the presence in the spinal fluid of increased cells and protein and for the Wassermann reaction. According to Gennerich,[5] these changes are due to a histologic neurorecidive, and are found up to the third year in from 40 to 60 per cent. of early cases. Gennerich believes that the degree of change in the pia-arachnoid determines whether there will be eventual changes in the neuraxis of a metasyphilitic type, and he assumes that the pia-arachnoid serves as a barrier between the cerebrospinal fluid and the neuraxis. If the pia-arachnoid is pathologic, fluid diffusion occurs into the nervous tissue with the occurrence of pathologic changes.

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[4] Ravaut, P.: Presse méd. 1919, No. 57.

Wechselmann,[6] in 1912, reported changes in the cerebrospinal fluid in the preroseolar period of syphilis. Plaut,[7] in considering the question of nervous involvement in early syphilis, speaks of the neurotropism of strains of spirochete, a belief engendered principally by the work of Fournier, Levaditi and Marie,[8] and concurred in by many workers, including Nichols and Hough,[9] and Reasoner.[10] Plaut describes the finding of spirochetes in the cerebrospinal fluid of patients with early syphilis, but is doubtful if this is the beginning of syphilis of the central nervous system. He says there is no proof that the presence of organisms in the fluid has any relation to late syphilis of the nervous system, since most of the cellular reactions disappear from the fluid spontaneously or as a result of early treatment. Both Gennerich and Mulzer have reported cases showing spirochetes in the fluid with negative biologic reactions. Wile and Hasley [11] believe that the so-called early preroseolar meningeal involvement which they found in forty-nine of two hundred and twenty-one cases "is for the most part transitory and without subsequent or permanent damage because in the majority the fluid was rapidly restored to normal under the influence of treatment and doubtless might have disappeared even without this treatment, like the early rash of syphilis." According to these authors, the appearance of positive fluid findings before the Wassermann reaction in the blood becomes positive is evidence of generalization and not of neurotropism. Stokes,[12] on the other hand, declares that early pleocytosis means involvement of the central nervous system in the sense of other tissue involvement in early syphilis. According to Dreyfus,[3] an observer of extensive experience, pathologic changes in the fluid indicate infection of the neuraxis. He believes that these can recede spontaneously only in the early stages. He found changes in 80 per cent. of his cases in the early stage, but includes as evidence of pathologic change, pressure above 180 mm. of mercury, to which we ascribe little or no importance. Fordyce [13] says the "activity of a syphilitic process in the central nervous system is indicated much earlier, more accurately and often only by the cytologic changes in the spinal fluid which should always supplement the physical examination."

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[5] Gennerich, W.: Berlin, in 1913; Hirschwald: Die Liquorveränderungen in den einzelnen Stadien der Syphilis, Deutsch. med. Wchnschr. **44**:1243, 1918.

[6] Wechselmann, W.: Deutsch. med. Wchnschr. **38**:1446, 1912.

[7] Plaut: Deutsch. med. Wchnschr. 1919, No. 48; Ztschr. f. d. ges. Neurol. u. Psychiat. **52**:193, 1919; Neurotherapy, **1**:76-88, 1919; **74**:988, 1920.

[8] Levaditi, C., and Marie, A.: Rev. de méd. **37**:193, 1920.

[9] Nichols, Henry J., and Hough, William H.: J. Exper. Med. **19**: No. 4, 1914; Demonstration of Spirocchaeta Pallida in the Cerebrospinal Fluid, J. A. M. A. **60**:108 (Jan. 11) 1913.

[10] Reasoner, M. A.: Some Phases of Experimental Syphilis, J. A. M. A. **67**:1799-1805, 1916; Early Death from Cerebral Syphilis, with Successful Rabbit Inoculation, ibid, **66**:1917 (June 17) 1916.

[11] Wile, U. J., and Hasley, C. K.: Involvement of Nervous System During Primary Stage of Syphilis, J. A. M. A. **76**:8 (Jan. 1) 1921; Serologic Cure (?) in the Light of Increasingly Sensitive Wassermann Tests, ibid. **72**:1526 (May 24) 1919.

Observers both here and abroad differ in the quantitative interpretation of spinal fluid findings. Thus, Cornaz [14] speaks of 2.4 cells per cubic millimeter as normal. Wile and Hasley [11] set an arbitrary normal of 8 cells and state that an increase of one or two cells can hardly be accepted as definite proof of involvement. Dreyfus [3] considers more than 5 cells as pathologic. Fildes, Parnell and Maitland [15] refuse to accept the high percentage of involvement published by Ravaut in view of the fact that abnormality is often based solely on the finding of 10 cells per cubic millimeter. They state that few of these cases show any abnormal signs such as would produce disability and many show no discoverable signs of disease.

Obviously, we need a standard of serologic normality, and this we have attempted to determine. We have examined thousands of fluids from patients with and without demonstrable involvement of the central nervous system from all types of specific and nonspecific disease, and we have come to look on from 8 to 10 lymphocytes per cubic millimeter as within the bounds of normality. These figures may appear too high, but we believe it safer to set a standard which, if exceeded, in all probability means meningitic change. Indeed, a slight increase above this normal in the absence of clinical signs or symptoms, unless accompanied by definitely increased globulin or by a positive Wassermann reaction, is probably of little significance. Persons without change in the central nervous system on whom spinal puncture is performed as a routine for general diagnosis, occasionally show as high as from 8 to 10 cells without globulin increase or other pathologic changes. On the other hand, definite syphilitic cases often show no increase in cells.

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[12] Stokes, J. H.: M. Clinics N. America **2**: 1919.

[13] Fordyce, J. A.: Am. J. M. Sc. March, 1921

[14] Cornaz, Georges: J. Nerv. & Ment. Dis. **49**:282 (April) 1919.

[15] Fildes, Parnell and Maitland: Brain **41**:255 (Nov.) 1918.

Cases of nonsyphilitic disease of the nervous system, such as multiple sclerosis, tumors of the cord and brain, chorea, epilepsies and other conditions frequently show 5 or more cells to the cubic millimeter without demonstrable meningitic change.[16] It is well to bear in mind that pleocytosis is often rapidly influenced by puncture only or antispecific treatment—a drop to normal limits from a fairly high count not being infrequent.

Increased protein content has always been looked on as evidence of organic change. It is supposed to be the earliest sign to appear and the last to disappear either spontaneously or as a result of treatment. On the whole, it may be said to go hand in hand with cell increase. It may be the only abnormal sign present in the fluid. By itself, globulin increase is of little significance in syphilis of the nervous system, and, unless looked on as a corroborative sign of other biologic phenomena, could be dispensed with in routine diagnosis.[17] A positive Wassermann reaction is of more significance, especially if the reaction is present in all dilutions from 0.1 c.c. upward. We have adopted 1 c.c. of fluid as the maximum amount. In the earliest stages of syphilis a positive reaction with large amounts of fluid is occasionally a transient phenomenon and may possibly be due to a transference of syphilitic reagin through the choroid plexus or other secreting surfaces of the pia-arachnoid. A persistently positive Wassermann reaction of the fluid, when present in early syphilis with pleocytosis and globulin increase, especially if the reaction is present in all dilutions, even in the absence of clinical symptoms referable to the central nervous system, should be looked on with suspicion, and calls for persistent treatment and lumbar puncture from time to time in the control of the therapy.

We consider the colloidal gold test of little value in early syphilis. In neurosyphilitic conditions it may serve to corroborate the other tests, but may be found in the absence of all other phenomena. As an indication of the eventual development of paretic changes, the so-called paretic curve should not be relied on. (We do not believe the paretic curve is diagnostic of general paresis, even though most paretic fluids give it.) In other words, given an early case of syphilis with serologic reactions persistently positive, even with a positive blood reaction and the so-called paretic curve, we believe that we cannot today prognosticate the development of parenchymatous syphilis.

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[16] All counts should be made within an hour or two of puncture. A standard chamber should be used—the Fuchs-Rosenthal. If microscopic blood is present, the number of cells to an equivalent field should be noted. Frankly bloody fluids are not available for counts.

[17] In estimating globulin increase it must be emphasized that only those fluids should be tested which are microscopically free from blood or contain at most a few red cells to the cubic millimeter.

In short, we believe that a mere increase in cells (pleocytosis) and in protein (globulin) with a transient Wassermann reaction point to irritation of the pia-arachnoid of the nature of a general septicemic reaction, temporary, and of doubtful significance as to the future involvement of the neuraxis.[18] The constant presence of cells, globulin and a definite Wassermann reaction in all dilutions in early syphilis indicate a more serious membrane involvement, possibly the earliest signs of a definite organic involvement of the neuraxis.[19] This view is tentative despite the fact that we have observed cases of syphilis from their incipiency with persistent serologic reactions with no subjective or objective clinical manifestations, over a period of ten years. The literature is curiously lacking in adequate statistical studies of cases with such persistent serologic reactions (serologic neurosyphilis) which have eventually developed definite involvement of the central nervous system.

It is a fact to remember that patients with vascular neurosyphilis may show no change in the cerebrospinal fluid—occasionally the blood Wassermann reaction is positive—but may suffer from serious damage due to vessel closure or rupture. These patients often are young people with early syphilis. They must be borne in mind when interpreting biologic data and when forming a prognosis based on tests of the cerebrospinal fluid.

INFECTION OF CENTRAL NERVOUS SYSTEM

One of the most important questions to be considered is the time of infection of the central nervous system. Morphologic studies are entirely lacking to decide this point. The biologic reactions are not conclusive. The idea that spirochetes enter the central nervous system in the early stages of the infection or not at all, and lie dormant in relatively nonvascular regions but possess the potential power of later multiplication and assumption of virulence in response to some unknown stimulus, is still unproved. Is it not possible that spirochetes wander into the central nervous system from without and, finding a less resistant or more fertile soil, become active?[20] If spirochetes do lie latent in the neuraxis for years, as stated by Warthin,[21] what is responsible for this so-called immunity or failure to react? If immunity exists in syphilis, it has not been proved by the demonstration of immune bodies, antibodies, in the blood or spinal fluid. Clinically, soon after the chancre, even before the generalization of the virus, the body becomes insusceptible to reinoculation with syphilis and in the vast majority of cases remains so. Even in a patient with a case of syphilis of long standing when the "immunity" has become attenuated, if it ever does so, reinfection is rare, even after years of therapy and with absolutely negative serologic reactions, so that when we speak of immunity in syphilis, we are using an empiric term, not one scientifically exact.

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[18] If the early spinal fluid changes found in so high a percentage of syphilitic patients were indicative always or even frequently of invasion of the central nervous system by the spirochete, it is difficult to understand why symptomatic syphilis of the central nervous system is not more frequently encountered. We know that the neuraxis as a rule is susceptible to slight irritation or invasion by virulent organisms, and the nervous system in early syphilis should therefore in the circumstances respond with productive or other types of inflammation to an invader like the spirochete at a stage when the germ possesses its maximum virulence and the body resistance is at its lowest.

[19] Fraser, A. R.: Am. J. Syphilis, **5**: No. 2, 1921. Fraser believes that the presence of serologic reactions in the fluid in the absence of clinical signs of involvement of the central nervous system points to the presence of an ample antibody supply with protection of the neuraxis, while the negative reaction means that the central nervous system has escaped involvement or that it has failed to react, which, he cannot tell. He believes that the positive early reactions in the fluid mean that the nervous system has reacted and therefore the prognosis is better.

We speak of antibodies produced in response to syphilitic infection being responsible for so-called immunity in syphilis, or of protective antibodies being present in the blood and spinal fluid, detectable by the Wassermann reaction. All this is hypothetical. There is no proof fulfilling immunologic requirements. We know that the antigen of the Wassermann reaction is of lipoidal nature and that the spirochete itself cannot thus be practically utilized; further, other protozoan diseases definitely not syphilitic give a high percentage of positive Wassermann reactions. Wassermann[22] himself has recently shown that there is present in the serum of syphilitic patients a substance that in the presence of complement enters into a reversible combination with the Wassermann antigen. The extract does not consist of the disease producing spirochetes or other protein material, but of alcohol-soluble, fat-like substances (lipoids) which are derived from animal organs.

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[20] Brown and Pearce showed that rabbits which recovered from clinical manifestations of syphilis are still infected and may continue to harbor virulent spirochetes in certain lymph nodes. The points of rest during latency are possibly chiefly the lymphoid tissues of the animal. Arzt and Kerl Wien. klin. Wchnschr. **27**:29 (July 16) 1914, reported finding in lesions about the genitals and in the regional lymphnodes of normal rabbits spirochetes absolutely identical morphologically with *Spirochaeta pallida*. These organisms were found in 26.9 per cent. of certain strains of normal rabbits. These observations have been confirmed by Jakobsthal, by Tomascewski, and in this country by Brown. These findings point out the necessity for great conservatism in accepting the conclusions drawn from rabbit inoculations and in our estimation call for a complete revision of all prior experimental inoculation work in rabbits.

[21] Warthin, A. S. Am. J. M. Sc. **152**:508, 1916.

[22] Recent experimental investigations on syphilis, Berlin letter, J. A. M. A. **76**:463, 1921.

This substance, which Wassermann recently isolated for the first time, is produced by the lipoid substance which must be present in large quantities in the blood of syphilitic patients. Wassermann attempts to prove a point heretofore unknown, namely: that lipoids as well as protein substances may produce genuine antibodies, thus explaining why the so-called antibodies present in syphilis were directed not against the specific spirochete of the disease, but against lipoids produced by spirochetal action on the tissue cells of the body. He asserts that the syphilitic patient thus suffers from an inversion of lipoid metabolism.[23]

In a recent paper Fraser [24] speaks of increase of neurosyphilis due to intensive treatment by arsphenamin in early syphilis after generalization causing rapid sterilization with loss of antibody protection for the central nervous system. He thinks that because of a lack of vigorous cell reaction, the spirochetes penetrate into relatively nonvascular areas of the central nervous system; that the central nervous system produces few or no antibodies and is dependent for protection on those produced as a result of the early general reaction. This is only a restatement of the views of Gennerich,[5] who holds that treatment, especially if insufficient, during the period of early dissemination, hinders generalization of the spirochete and causes lack of immunity. Spontaneous cure of the early disease does not destroy this early ample immunologic response, and the stronger the immunity the fewer the neurorecidives (meningitic or other). Local foci of spirochetes develop in the presence of a lesser immunity caused by insufficient treatment or when generalization is hindered. In other words, by means of insufficient early treatment or by a restriction of early immunity formation we have instead of the sterilisatio magna of Ehrlich, a sterilisatio fere completa. These views are combated by Matzenauer,[25] according to whom the severity and type of lesions are explainable on the basis of constitutional factors and individual susceptibility.

If immunity exists in syphilis, as is claimed because of the long period of incubation and invasion, the protracted latent period and various other phenomena, such as rare reinfection nonautoinoculability, we have as yet no scientific proof of this hypothesis.

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[23] Brown, W. H., and Pearce, L.: J. Exper. M. **31**:749, 1920; **33**: (May 1) 1921; Am. J. Syphilis, **5**:1, 1921. In a series of rabbit experiments these authors have shown that in animals inoculated intratesticularly with virulent strains of spirochetes, those given one injection of arsphenamin and subsequently reinoculated after the disappearance of early clinical symptoms, developed typical reinfections in the shape of a second chancre, while the untreated infected controls failed to react a second time. By these experiments they attempt to prove that even in uncured syphilis, reinfection is possible if the resistance is lowered by insufficient "immunity" reaction.

[24] Fraser, A. Reith: Am. J. Syphilis **5**: No. 2, 1921.

[25] Matzenauer, R.: Wien. klin. Wchnschr. **32**:831, 1919.

The question of neurotropism of spirochetes may be merely glanced at. Some believe that certain strains have an elective affinity for the nervous system. In spite of the extensive animal work of Levaditi and Marie,[8] of numerous assertions of the rarity of nervous involvement among negroes, of cases of conjugal neurosyphilis, of the variation in morphologic appearances of certain types of spirochetes and of numerous instances of neurosyphilis in persons infected at the same source, we hold with Sicard,[26] Nonne[27] and a host of others that actual proof of the presence of special strains of the spirochete is as yet lacking.

Among our patients, and others have made similar observations, are persons infected at the same source, some of whom developed nervous lesions while their partners did not.

TREATMENT OF SYPHILIS OF THE CENTRAL NERVOUS SYSTEM

Our own results in the eradication of clinical and biologic signs in the first year following infection with almost complete prevention of serious invasion of the central nervous system when treatment has been intensive enough, leads us to believe in the institution of therapy at the earliest possible moment and of such an intensity as is compatible with the patient's welfare. The proper care of a patient with syphilis of the nervous system demands that the physician be conversant with modern laboratory diagnosis, equipped to evaluate the biologic data, able to make a detailed neurologic examination and especially capable of reaching a logical and practical conclusion after digestion of all the evidence.

We strongly believe in the efficacy of combined treatment in most forms of syphilis of the central nervous system, with certain notable exceptions. We feel sure it is wise to adapt the treatment to the patient in the more chronic types of syphilis of the central nervous system rather than to carry out a stereotyped plan designed to eradicate biologic phenomena of the disease.

Let us realize that neurosyphilis cannot be judged or classified by the outcome of biologic reactions alone, but that of equal, often greater, importance are the clinical factors. Absolutely essential is a knowledge of the possibilities and limitations of various forms of therapy; also, a broad grasp of the patient as a complex human being with a psyche, not merely as a bundle of biologic phenomena to be made negative. We wish to protest against a form of therapy that often has a mortality of 20 per cent. (intracranial therapy) with merely promising results, and against all extra-hazardous and painful forms of therapy that do not offer more than a debatable chance for even prolongation of life, not to speak of cure.

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[26] Sicard, J. A.: Soc de neurol. de Paris, July 9-10, 1920; Presse méd. **28**:52, 1920; **28**:281, 1920; Médicine, Paris **2**:3 (Nov.) 1920.

[27] Nonne: Syphilis und Nervensystem, Berlin, 1915.

Examinations of blood and spinal fluid in the so-called preclinical stage of syphilis of the central nervous system are of great importance. The case of the patient with fully developed neurosyphilis of any type is different. At this stage objective clinical signs are present and laboratory data must be looked on as corroborative, even though occasionally in the presence of dubious or merely suspicious clinical evidence, laboratory data may be the determining factors.

Treatment of Patients with Acute Cases.—In our previous paper we divided the cases clinically into three groups. In the first we placed all urgent cases with acute symptoms requiring immediate and intensive treatment, as well as all early cases of cerebrospinal syphilis of any type, early tabes and cases of general paresis. Toward these cases we have gradually assumed a more conservative attitude. We no longer follow the plan of Dreyfus, and we rarely give intravenous medication oftener than twice a week—more frequently only every five days until urgent symptoms are abolished, when the case is placed in Group 2, which includes the more chronic types of cerebrospinal syphilis, tabes and certain cases of general paresis. We rarely exceed 0.4 gm. of arsphenamin or its equivalent. The first injection we make minimal to avoid a Herxheimer reaction. In involvement of the medulla, optic or other cranial nerves, if time permits, we precede the injection of arsphenamin by one or two of a soluble mercurial (mercuric chlorid or succinimid) to prevent too intensive action by the arsenical. During the administration of any antisyphilitic in acute medullary involvement, the pulse and respiration are carefully guarded from the too intensive action of any spirocheticidal remedy. In the more chronic group, arsphenamin is given not oftener than once a week and in doses ranging from 0.25 to 0.4 gm., never higher. We believe that the spirocheticidal remedies are of no value if they exert their toxic action. We aim to get the tonic action of the arsenicals for chronic sufferers from specific nervous disease.

General Paresis.—As regards general paresis, we are convinced of the futility of intraspinal and intracranial therapy, which we unhesitatingly condemn. Well developed cases treated in groups for comparison did as well on one type of treatment as on another.[28] All eventually succumb. The tendency of dementia paralytica to sudden remissions, even intermissions, must always be borne in mind. Patients with early cases frequently are astonishingly benefited by intravenous injections of arsphenamin, combined with injections or inunctions of mercurials, and exhibit prolonged remissions during which it is often quite impossible to detect any signs of mental aberration. The diagnosis of general paresis may offer exceptional difficulties even in the presence of positive biologic reactions in the blood and spinal fluid. In the absence of definite mental symptoms there has been a growing tendency to call these cases "serologic" paresis, paresis sine paresi.[29] The criteria of Darling[30] for true paresis are: speech disorders, pupillary changes, reflex changes, amnesia, quick shifting emotions, character changes and conduct slump. In the hope of a prolonged period of remission or that possibly what we believe to be paresis may prove to be a more hopeful cerebral syphilis, we practice persistent treatment of these cases.

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[28] Darling, I. A., and Weston, P.: Penn. M. J. **22** (March) 1919 (discussion). Jackson, J. A., and Pike, H. V.: Interpretation of Wassermann Reaction of Blood Serum in Mental Diseases, J. A. M. A. **76**:360 (Feb. 5) 1921.

Lumbar Puncture.—This brings up the question of lumbar puncture. We believe that on every patient with early syphilis lumbar puncture should be performed at least once, preferably at the end of the first year of treatment and earlier if indicated by clinical evidence of involvement of the nervous system. If the result is negative, it need not be repeated, if treatment is continued, until the third or fourth year. If then negative, in the absence of clinical signs of nervous syphilis, we do not repeat it(see plan). If positive, we do not repeat it oftener than once a year during the continuance of therapy. In latent cases or in late cases of syphilis with any suspicion of nervous or mental change, of course we perform lumbar puncture as a diagnostic measure. During treatment, we believe that a great deal of harm may be done by too frequent tappings. We are guided by the clinical symptoms and the blood reaction, reserving puncture for the completion of treatment. As therapeutic indications we are guided first by the clinical symptoms and objective signs, to a lesser degree by the outcome of the tests. We are not inclined to agree to the performance of puncture in the outpatient department or consulting room, but insist on at least one day's rest in bed immediately following tapping

Résumé of Treatment of Syphilis of the Central Nervous System.—Intraspinal Therapy: A review of the literature has shown a growing tendency in this country to restrict intraspinal treatment to very narrow limits which has been largely due to the efforts of Sachs and his associates. In Europe with few exceptions there has been a general abandonment of intraspinal methods.

Our former opinion, which we still hold, of the very limited value of intraspinal treatment was based on these facts:

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[29] Southard and Solomon: Boston M. & S. J. **24**:1.

[30] Darling, I. A.: Am. J. Syphilis **3**:35, 1919.

1. The amount of arsenic present in auto-arsphenamized serum was infinitesimal and of no spirocheticidal value.
2. There was no valid proof that arsphenamized serum was in itself spirocheticidal in vivo.
3. It was impossible to reinforce blood serum with more than an infinitesimal amount of arsphenamin.
4. The introduction directly into the cerebrospinal fluid of any of the arsenical preparations was often dangerous and occasionally exceedingly painful. When nontoxic quantities were used the remedy was impotent.
5. The pathologic changes in the various types of syphilis of the central nervous system are rarely only superficial, and are not reached by injection into the subarachnoid space.
6. The method was physiologically wrong. Nutrition of the cerebrospinal tissues is not afforded by the cerebrospinal fluid which serves as an hydrostatic agent for the suspension of the brain and cord and an avenue of excretion. Therefore, medication of the nervous tissues via the cerebrospinal fluid was impossible. Substances introduced into the cerebrospinal fluid are rapidly absorbed into the blood and rarely diffuse through the subarachnoid space. The direction of flow in the so-called perineuronal lymph space is away from the nervous tissue toward the cerebrospinal fluid. The pressure in the cerebral capillaries is greater than that of the cerebrospinal fluid so that fluid leaves the capillaries rich in material circulating in the blood, circulates in the pericapillary and perineuronal spaces, yielding nourishment and receiving waste matter, and finally leaves the tissues by the pericapillary and perivascular spaces to the subarachnoid cavities over the surface.
7. Arsenic injected intravenously regularly reached the cerebrospinal fluid in greater quantities than could possibly be injected intraspinally without damaging or destroying the nervous tissue. This is true also of mercury and iodids.
8. If the meninges are the seat of an acute or chronic inflammation, "antibodies" circulating in the blood stream reach the subarachnoid space. Intraspinal injections may serve to irritate the secreting mechanism and thus render it more permeable. Spinal drainage may act in a similar manner, as well as the reduction of fluid pressure.

If intraspinal therapy were a simple and harmless procedure, there would be little reason for an attempt to restrict its use. But we feel that the teaching of Fordyce and his followers is responsible for opening the door to a great deal of misguided and harmful effort due to lack of knowledge of the indications of this form of treatment, of failure to appreciate the true significance of the various biologic factors present in the disease, and above all, of insufficient experience in the various clinical manifestations of syphilis of the central nervous system. In our previous paper we showed fallacies in the conclusions of these therapists and we believe that time has shown the narrow limits for this form of therapy.[31]

In optic atrophy intraspinal therapy is not contraindicated, but we feel that the disease, if not too far advanced, may be as satisfactorily rendered stationary or retarded in its progress by intravenous therapy. It is questionable whether serum administered in the lumbar region ever reaches the region of the base near the origin of the optic nerves. In properly regulated dosage if preceded by mercury and reinforced by iodids, arsphenamin has no harmful effect on the optic nerves.

If we restrict the use of intraspinal therapy, as Fordyce[32] has stated, to cases which after intensive treatment with arsphenamin, mercury and potassium iodid, show little or no improvement in symptoms, blood or fluid reactions, its field will be small indeed. It should by all means be a second rather than first choice in the treatment of neurosyphilis. Fordyce[13] now advocates its use especially in the early invasive period when the biologic reactions persist in spite of intensive therapy. On the one hand, Fordyce advocates the removal of these biologic reactions by intraspinal and combined therapy, and on the other, McDonagh,[33] Fraser,[24] and others advocate their retention as an evidence of reaction on the part of the neuraxis with protective antibody formation, a sign of good omen. As we have shown, the importance of these early reactions as regards actual involvement of the central nervous system has been misunderstood by Fordyce and others. McDonagh denies the efficacy of intraspinal therapy because in spite of it, late degenerative lesions may occur. In our opinion, the mere presence of spinal fluid changes in early syphilis does not call for intraspinal therapy, because these signs are transient and do not, in the vast majority of instances, necessarily signify nervous changes and only quite exceptionally resist treatment by arsphenamin intravenously and mercury. Here again we are adverse to the use of intraspinal therapy, except in the very rare instances in which a few years of proper treatment have left unchanged all the biologic reactions in the fluid.[34]

In the following plan we have briefly summarized our methods of procedure in all stages of neurosyphilis, as well as in early constitutional syphilis.

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[31] What we believe these limits to be will be found in our article referred to in Footnote 1. Lack of space forbids their insertion here.

[32] Fordyce, J. A.: Am. J. Syphilis **3**:341, 1919.

[33] McDonagh, J. E. R.: Venereal Diseases, London, 1920.

[34] In addition to the references given, the following may be of interest: Sachs, B.: J. A. M. A. **69**:681, 1917; Arch Neurol. & Psychiat. **1**:277-284, 1919.

Dercum, F. X.: The Functions of the Cerebrospinal Fluid with a Special Consideration of Spinal Drainage and of Intraspinal Injections of Arsphenamized Serum, Arch. Neurol. & Psychiat. **3**:230 (March) 1920.

PLAN OF PROCEDURE IN SYPHILIS OF THE CENTRAL NERVOUS SYSTEM

GROUP 1

Cases Requiring Immediate and Intensive Treatment:

- Early cerebrospinal syphilis—at onset of or early in:
  - Meningitis
  - Meningomyelitis
  - Meningoencephalitis
  - Cerebral and spinal endarteritis (fresh insult)
  - Optic neuritis—advancing
  - Syphilitic epilepsy—earlier cases
  - Pseudo tabes
  - Ophthalmoplegias
- Early tabes dorsalis—with acute symptoms, pains, crises, etc.
- General paresis—with acute manifestations
- Treatment—unless contraindicated:
  1. Arsphenamin (or equivalent) 0.2 to 0.4 gm. every three to five days until symptoms are controlled, then 0.4 gm. every week—six to eight injections in each course. First course followed by treatment as in Group 2.
  2. Mercury by deep intragluteal injections. Soluble salt every two to three days, alternating with above until symptoms demand less intensive treatment. Then follow injections by arsphenamin with weekly injections of insoluble preparations as in Group 2.
  3. Iodids by mouth, if possible, rectally or intravenously otherwise.
  4. Lumbar puncture for relief of coma, secondary hydrocephalus symptoms, root pains.

GROUP 2

More Chronic Cases—Later Stages of Group 1

Cases with persistent biologic reactions—general paresis:

1. Arsphenamin (or equivalent) 0.25 to 0.4 gm., once weekly or every ten days—six to eight injections followed by mercury.
2. Mercury, insoluble preparation every five days—or soluble preparation thrice weekly for two months or thirty rubbings.
3. Iodids by mouth, rectum or intravenously to point of tolerance for one month following mercury or alternating.
4. Sodium nucleinate intragluteal injections 0.3 to 1.0 gm. or more to induce febrile reaction—every 3 to 7 days—in general paresis and occasionally in resistant tabetic or spastic cases.
5. Reeducation—method of Maloney.
6. Symptomatic—baths, massage, medicinal for pain, bladder symptoms.

Repeat once or twice during the first year as indicated by benefit derived, the condition of the patient's excretory organs, morale, biologic reactions, etc. Subsequently yearly or more or less often, gradually tapering off. See Group 3.

GROUP 3

Late Cases of Tabes Dorsalis, Cerebrospinal Syphilis, Optic Atrophy, Spastic Paraplegia, and Cases of Group 2 after Three Years:

No attempt to influence biologic reactions, treatment mainly symptomatic and supportive.

1. Arsphenamin, 0.25 to 0.4 gm. every two weeks, not more than six injections in all; only if well tolerated.
2. Mercury by inunction or injection following No. 1.
3. Iodids by mouth, following No. 2.
4. Reeducation, method of Maloney.
5. Symptomatic, control of crises, bladder symptoms.

AUTHORS' METHODS OF TREATMENT IN EARLY CONSTITUTIONAL SYPHILIS

Treatment in Primary Syphilis:

Attempt at abortion of disease
Intensive intravenous arsphenamin therapy
Followed by mercury, rapid sterilization methods (Pollitzer, Scholtz)
Less intensive plans
Repetition of courses during first year.

Treatment of Secondary Syphilis—First Year:

(*a*) Attempts to eradicate symptoms.

(*b*) Attempts to eradicate biologic reactions: Arsphenamin intravenously every other day for three injections, then once weekly for five injections, followed by mercury twelve insoluble injections, twenty-four to thirty soluble injections. Rest from six to eight weeks, if symptomless, then arsphenamin weekly, for eight injections. Mercury, twelve insoluble injections, from twenty-four to thirty soluble injections. If Wassermann negative, rest for from two to three months. If Wassermann positive, repeat above treatment after from six to eight weeks' rest.

(*c*) Lumbar puncture: At the end of the first year, if the Wassermann reaction is negative and symptomless. At the end of second course, if the Wassermann reaction is positive or if there are symptoms of cerebrospinal involvement.

Treatment of Secondary Syphilis—Second Year:

(*a*) Symptomless—biologic reactions negative blood and cerebrospinal fluid—one course treatment—from four to six injections of arsphenamin, six injections of mercury.

(*b*) Symptomless—blood Wassermann reaction positive—cerebrospinal fluid negative. Two course treatment, six to eight injections of arsphenamin, twelve injections mercury insoluble, twenty-four to thirty injections of mercury soluble.

Treatment of Latent Syphilis:

After second year, Wassermann blood reaction positive.

1. Lumbar puncture to be advised. (*a*) Blood Wassermann reaction positive, cerebrospinal fluid negative. Treat as (*b*) above. (*b*) Cerebrospinal fluid positive—blood positive. Treat as Group 1 for one course, rest six to eight weeks, then arsphenamin weekly for six injections followed by mercury.
2. Repeat each year as indicated by symptoms and presence of biologic factors.

DISCUSSION

Dr. Walter F. Schaller, San Francisco: I have been interested in the pathogenesis of certain types of neurosyphilis and in the early diagnosis of this disease. My associate, Dr. Henry Mehrtens, has been occupied with studies of the cerebrospinal fluid, its pressure, circulation and absorption, and with the permeability of the meninges to drugs. Conjointly, along these lines, we believe to have found a justification for intraspinal treatment. In advanced cases, we can only hope for an occasional arrest and some symptomatic benefit. I believe that in certain forms of neurosyphilis, particularly in the meningeal form. such as tabes, we have obtained benefit when intravenous treatment has failed. In our experience the method is not dangerous although it requires a rigid aseptic technic. We give all our treatments in the hospital. There have been no more accidents in our series than in a corresponding number of arsphenamin injections alone. The intraspinal treatment includes, in addition to intravenous treatment, drainage and what additional benefit the application locally of specific medicines may have. The benefit has been both symptomatic and serologic. These patients return to us voluntarily, requesting further treatment, in spite of the physical discomfort and considerations of time and expense, because they are convinced that they have been helped.

Dr. Harry C. Solomon, Boston: Some patients do not respond well to intravenous treatment, but do respond very well to intraspinal therapy. These patients have developed essentially negative blood and spinal fluid findings and have improved their symptoms. We have treated our cases of neurosyphilis with intensive intravenous remedies for many months. In the last six months I have seen patients treated for three or four years with arsphenamin, mercury and iodids without effect, who after two, three, four or five intraspinal injections gave practically negative spinal fluid findings. There is some effect from intraspinal therapy, all theories to the contrary notwithstanding.

Dr. Harold E. Foster, Boston: Several cases of primary optic atrophy, (syphilitic), have been treated for a number of years at the Massachusetts General Hospital according to the Swift-Ellis method administered intracisternally. The first patient selected for this method had been under intravenous arsphenamin treatment for about a year with slowly steadily contracting fields. In about four months from the first intracisternal treatment of arsphenamized serum the fields were of the same size as in the first examination. The process had apparently been checked. About six months later the fields were expanded slightly. One other patient who has been faithful to treatment was greatly benefited. Most of these optic atrophy cases are sent us by the oculists after the disease has progressed rather far. If the neurologic departments could get these cases in the early stages, this intensive treatment would obviate these extreme conditions, but many patients come to us when they are only able to distinguish daylight from darkness. Without exception we have had results with the intracisternal arsphenamized serum administration which were not obtained by the intravenous route.

Dr. Henry F. Stoll, Hartford, Conn.: I have had patients who continued taking intraspinal treatments even though they had a reaction after each treatment because they felt better than after the intravenous treatments. I do not think that intraspinal treatments should be given in all cases, but when the symptomatic and serologic improvement is not satisfactory, they should be resorted to. Patients showing the paretic curve with a positive Wassermann reaction in a small amount of spinal fluid should be given the advantage of both intravenous and intraspinal therapy as soon as they come under observation. The paretic curve does not signify paresis necessarily, but it probably is indicative of serious parenchymal involvement.

Dr. David J. Kaliski, New York: Our experience is based on the treatment of more than 500 cases by all methods of therapy. In the beginning when the Swift-Ellis method was first advocated we treated about 400 patients and some received as many as forty intraspinal injections. Occasionally, a patient improved clinically and serologically, but patients also improved after lumbar puncture and normal serum intraspinally; in the vast majority of cases also if intravenous treatment alone was properly carried out. We do not mean arsphenamin intravenously alone, but the use of mercury and iodids in proper sequence and dosage with mental and mechanical therapy to increase the patient's morale and improve his general condition. These adjuncts are just as important factors as any one "kind" of treatment, and it also explains why some patients who are taken from one kind of treatment and put on another do well; it is because they are stimulated, buoyed up by new hope of cure, and their general condition improves. Intraspinal therapy should not be used in every case. That is what we desire to emphasize. As far as the improvement of optic atrophy after puncture of the cisterna magna is concerned, Dr. Foster cited only one case. This is hardly sufficient to do more than draw attention to the possibilities of the method. As to the paretic curve with the colloidal gold reaction, Dr. Tilney found, and we agree with him, that in about 155 cases the paretic curve did not indicate parenchymatous syphilis. The important point is that the paretic curve by itself does not mean paresis. The recital of a series of cases benefited by a given form of therapy is not a fair way of deciding the comparative merits of that form of treatment. Intraspinal therapy by itself, no matter how intensively applied, is not as efficacious, on the whole, as intravenous therapy, to say nothing of the comparative risks and inconvenience and expense to the patient. In the use of arsphenamin in syphilis of the nervous system we must avoid maximum dosage. Rarely use more than 0.4 gm. arsphenamin and 0.6 neo-arsphenamin. This applies to the intensive treatment in the early stages or in the later cases. It is all-important to avoid getting a toxic effect from too large or frequent dosage and to avoid any form of treatment that tends to disturb the morale of the patient with syphilis of the nervous system.

News and Comment

APPOINTMENT OF CHIEF OF DIVISION OF MENTAL HEALTH OF THE PENNSYLVANIA STATE DEPARTMENT OF PUBLIC WELFARE

Dr. William C. Sandy, Philadelphia, psychiatrist of the New York State Commission on Mental Defectives, has been appointed chief of the division of mental health of the Pennsylvania State Department of Public Welfare. The appointment became effective December 1.

Abstracts from Current Literature

RIGIDITY OF THE PUPILS AND THE CILIARY GANGLION FROM THE SPECIAL ROYAL RESEARCH CLINIC OF FLORENCE, DIRECTED BY PROF. E. TANZI. Cristoforo Rizzo, Riv. di patol. nerv. **25**:326 (April 4) 1921.

The pathologic anatomy of Argyll Robertson and fixed Rochon-Duvigneaud pupils is obscure, and the research work done in this connection is confusingly contradictory. Disturbances in various parts of the reflex arc for the pupillary movements have been held accountable for these signs. Déjerine places the lesion in the part connecting the anterior corpora quadrigemina with the third nerve nuclei; Mendel in the ganglia habenulae; Bechterew in the iridomotor nuclei of the third nerve; Mauthner in the third nerve roots; Wolf in the column of Goll in the medulla and Marina, Lafori and Sala place it in the ciliary ganglion. Marina found definite degenerative pathology in the ciliary ganglions and in the nerves of tabetic and paretic patients, who showed both the fixed and Argyll Robertson pupil. The roots of the ciliary ganglion were always found to be normal. The degenerated nerves were studied with Marchi, Weigert and the method of dissociation, the preparations being previously fixed with osmic acid. Marina is convinced that generally the degeneration begins in the ganglion cells of the ciliary ganglion, though it may less often begin in the nerves. Lafori also does not believe that these signs are due to lesions of the affective motor reflex arc (pain and emotional pupillary reflex pathways) but to sensorimotor reflex arcs subserving the light reflexes and accommodation-convergence reactions. Therefore the cause must be found in the ciliary ganglion and its peripheral neuron. André Thomas who did not, however, examine the ciliary nerve endings in the iris, reported three pathologic examinations with negative findings in the roots and ganglion of the ciliary nerve. This author used Cajal, osmic acid and picrocarmin stains.

Sala reported three observations in paretic patients with Argyll Robertson pupils, using the Cajal reduced silver nitrate stain. He believes that this sign is caused by the degenerative ciliary nerve and ganglion changes. The ciliary root was normal. In fixed pupils the roots, ganglion and nerves all showed more extensive changes.

Rizzo's studies were made of nine patients who had normal pupillary reactions and pupils, eight cases of paresis and one of tabes with Argyll Robertson pupils and one paretic with diminished light and accommodation reflexes and one paretic whose pupils reacted well.

The ciliary ganglion and nerves were carefully dissected out and treated with the following fixatives:

1. Ciaccio's liquid (aqueous solution of bichromate of potash 100, formaldehyd 20 and acetic acid 3 c.c.) for forty-eight hours and seven days of fixation in a 3 per cent. solution of bichromate of potash.
2. Lugaro's fixative (alcohol 100 c.c., nitric acid 5).
3. Alcohol, 95 per cent.
4. Ammoniacal alcohol (Cajal's formula).
5. Piridin.
6. Formaldehyd, 10 per cent.
7. Saturated solution of mercuric chlorid.

Most of the ganglions and ciliary nerves were treated with Ciaccio's liquid alone and then stained with sudan III or with Mann's mixture (aqueous solution of eosin and methylene blue). All the sections fixed with Ciaccio's fluid were stained also with fuchsin green (Alzheimer's solution No. 6) and with negrosin. Other staining methods were Cajal's silver stain, and those of Daddi, Spielmeyer, Bielschowsky and Biondi.

The ciliary nerves were sectioned in their entire course retrobulbar-intraocular and even to their terminations in muscle of Brücke, the iris and cornea.

The author warns against being deceived by staining artefacts caused by the various reagents and often interpreted as sclerosis, particularly of the large ganglion cells which predominate in the ciliary ganglion.

The author finds that the ganglion cells have a pigment which increases with age, such as occurs in sympathetic ganglion cells, but it is never as great as the amount of pigment seen in ganglion cells from the superior cervical ganglion. This pigment is best stained with Pappenheim's methyl pironin-green. The pigment is of two kinds, which in the author's tables are designated pigments A and B, and the differentiation is made according to the coloring given with any one of the several staining and fixing methods mentioned in the foregoing.

Pigment A is scanty and exclusively found in the small ganglion cells. It is present as small discrete granules sparsely spread throughout the cytoplasm, which is not rich in chromatic granules ordinarily. Only three or four cells in each section contain it. It occurs earlier than pigment B and does not tend to increase with age.

Pigment B is, however, abundantly present, occurs later and is exclusively found in the large ganglion cells. It occurs in closely packed granules, in clumps or in semilunar shapes in the most external part of the cytoplasm. This pigment increases with age or with the duration of the illness.

Pigment A of the small ciliary ganglion cells has many points in common with the pigment in the substantia nigra of Soemmering.

A short discussion of the minute anatomy of the ciliary ganglion, its preganglion and postganglion fibers, etc., precedes the author's description of the experimental methods used. The author felt that it was necessary to demonstrate that the staining methods used in the pathologic cases were sufficient and efficient. He therefore caused Wallerian degeneration of the ciliary nerves of a rabbit by cutting them just before they enter the sclera. Instantly this is followed by a fixed dilated pupil. The eye was enucleated forty-eight hours later and hardened in formaldehyd for several days. Sections of the cornea, Brücke's muscle, the iris and the sclera were cut and treated, the cornea with Bielschowsky's stain, the sclera, iris and Brücke's muscle with Daddi's and Spielmeyer's stain. Figures 19 and 20 of the author's article show the first phase of Wallerian degeneration in the myelin sheaths.

The ciliary ganglion of paretic patients with rigid pupils differs in no respect from the ganglion of normal persons (normal pupillary reactions). There was no diminution in the number of cells. The "piastrine" of Marina (spaces representing the residua of degenerated ganglion cells) are explained by the author as due to differences in the planes of the sections and not to degenerative processes. He stained various ganglions with Nissl's and Cajal's stains and proved this. The author reasons that if ganglion cells were gone they would be replaced by the interstitial connective tissue or by fibers from the capsule of the ganglions—but he found no such increase or replacement. The preganglionic ball-like endings about the ciliary ganglion cells in paretic patients having rigid pupils did not show any abnormalities. There was no thickening or break in their continuity or forking of these fibers. No vacuolization was found in the ganglion cells of tabetic or paretic patients with fixed pupils.

The pigments mentioned by the author as occurring in the two types of ganglion cells was not affected in paretic patients with rigid pupils. Fat pigment, however, was increased. Contrary to Marina's findings, chromatolysis was seen rarely and only in the large ganglion cells. The amount of lipoproteins shown by the sudan III, Nissl and Lugaro stains was greatly increased in some cases and was probably an acute cellular reaction occurring in the last few days of life. These changes were most typically seen in an old man of 80 years dying of bronchopneumonia. His pupillary reactions were normal. The chromatolysis in this case occupied more than half the cells. In this case the lesion could be interpreted either as one of long duration and its existence compatible with the presence of a normally functioning ciliary ganglion, or it occurred during the last few days of life. The first cannot be the case because there was no loss in the number of cells. However, in the ganglion cells of paretic patients only 3.5 per cent. of the cells showed this chromatolysis; therefore the phenomenon of rigidity cannot be caused by these limited cell changes. These chromatolytic changes are seen also in toxi-infections and might be considered by some as part of an axonic reaction. Marked perivascular infiltration was noted in all the sections from paretic patients with fixed pupils.

All the roots of the ganglion were found perfectly normal in tabetic and paretic patients with fixed or Argyll Robertson pupils. The common third nerve root was also normal.

The small ciliary nerves showed no pathology either in the myelin sheaths or axis cylinders in cases showing either fixed or Argyll Robertson pupils. These nerves were sectioned and stained throughout their entire course even to the iris and cornea and not one pathologic fiber was found in cases showing fixed or Argyll Robertson pupils. Both the fibers of long and short ciliary nerves were normal. This disproves the supposition that the chromatolysis seen in certain ganglion cells mentioned in the foregoing is part of an axonic degeneration but is a toxi-infectious reaction too recent to cause axonal degeneration of a secondary nature.

Conclusions.—The larger amount of pigment seen in the large ganglion cells of the ciliary ganglion is the ordinary fat pigment. The pigment of the small cells is distinctive and like that in the substantia nigra. The former increases with age and the chronicity of the disease while the latter does not.

Normally the fibers of the long and short ciliary roots are much finer than the fibers of the nerves they leave. In the oculomotor root those fibers leading to the intrinsic eye muscles are morphologically different from those leading to the extrinsic eye muscles.

No cellular degenerations of great importance were found in paretic and tabetic patients with fixed or Argyll Robertson pupils. Such cell changes as were found were due to terminal infections.

No connective tissue reaction was noted either in the ganglion capsule or as replacements of degenerated or vanished cells.

The roots of the ciliary ganglion, the intraganglionic fibers and the short ciliary nerves of paretic and tabetic patients with pathologic pupils did not show degeneration.

The nerve plexus in the muscle of Brücke and the fibers in the iris and cornea were normal.

Perivascular lymphatic infiltration was a constant finding in the ciliary ganglions of paretic patients.

The same methods used to discover alterations in the ciliary nerves of paretic and tabetic patients with rigid pupils have disclosed experimentally produced Wallerian degenerations in the ciliary nerves of rabbits, in the thickness of the sclera, in the muscle of Brücke, in the iris and in the cornea.

A fair bibliography and twenty-seven good illustrations, uncolored however, are given.

Osnato, New York.

CONCERNING MUSCULAR ATROPHY IN TABES DORSALIS. Herman Lippmann, Arch. f. Psychiat. u. Nervenkrankh. **63**:1, 1921.

This is a well written article in which the author takes up at length a very much neglected symptom in tabes, and makes the following general statements: 1. As a rule it attacks single muscles or a muscle group. 2. It usually occurs toward the end of a long drawn out disease; the muscles are then weak, anesthetic and atrophic. 3. When reaction of degeneration and fibrillary tremors are found the degenerative atrophy is certain, but when there is only a quantitative reduction in the electric excitability there is some doubt. 4. In general, the atrophy is usually limited to the lower extremities with a predilection for the lower part of the leg and then the foot. In the foot there is in tabes the characteristic "tabetic club foot" (pied bot tabetique; Joffroy). Occasionally the upper extremities are attacked, and then there is atrophy of the small finger muscles and the muscles of the thenar and hypothenar eminences. Of great importance is the atrophy of the shoulder girdle, giving the picture of an Aran-Duchenne type of atrophy, which is usually bilateral but not always equal. In occasional cases the trunk muscles, singly or in groups are involved. As a rule the atrophies as well as the arthropathies and the trophic disturbances of the skin occur in the later stages, but occasionally there is an exception. Charcot and Fournier have described a case in which the atrophy occurred in the preataxic stage. Lapinsky gives six cases of this in which paralysis with atrophy of various muscle groups began the disease. The classical cases with eye muscle symptoms are here briefly referred to.

The localization of the atrophy in the foot gives the characteristic "tabetic club foot" picture that is occasionally seen. The name "club foot," which Joffroy has given this condition, is perhaps not a happy one. It at first suggests a pes equinus. Other authors, as Leyden and Goldscheider, have used the words "club-foot deformity." The author suggests the term "tabetic pointed-curved foot." The author quotes this case: A woman aged 64, whose husband died of lung trouble, with previous negative family history, first complained of shooting pains in the legs at the age of 40. Nine years later after a severe menstrual bleeding, her legs became so weak that she was unable to walk, her gait being uncertain in the dark. Formication began in the extremities and the soles of the feet felt like fire. Two years afterward, both legs grew weak and she soon became bedridden.

The author examined the patient about ten years later and found the pupils small and of the Argyll Robertson type. The lower leg muscles on both sides showed atrophy and weakness. The greatest diameter of the calf was 25 cm. Both ankles were in a varus position; the feet were greatly distorted, the inner sides being more marked than the outer. The anterior part of the feet showed marked adduction. The first and second toes on both feet were bent and abduction only slightly possible. Electric reaction gave a quantitative reduction—more on the left than on the right. There was a disturbance for touch and pain sense was lessened up to the knee. There was a band around the chest at the fifth and sixth ribs. Both legs and the left arm showed marked ataxia. The deep reflexes in all extremities were absent. Corneal, vomiting and abdominal reflexes were normal. The blood Wassermann reaction was positive, the spinal fluid Wassermann reaction negative. Roentgen-ray examination of the feet revealed distinct bone and joint changes.

The author considers first the anatomy of the tracts concerned in this case and then the pathology. He states that Lapinsky and others have found that section of the posterior root causes changes in the cells of Clark's column and in the nerve cells of the anterior horn, changes which in their essentials consist of a swelling of the bodies and loss of Nissl bodies. From this standpoint he explains the atrophy in tabes. In general two theories oppose each other: one by Déjerine and the other by Lapinsky. Déjerine thinks that the muscle atrophy of tabes depends on a neuritis of the peripheral nerves, which takes place very slowly, at the distal ends of the nerves, especially, and proceeds slowly to the anterior roots. These changes in the nerves indicate a proliferation of the endoneural and perineural connecting substance. The muscles which these nerves supply have thin, round fibers which in portions fall apart and are filled with pigment. The connective tissue in these muscles is increased and rich in nuclei—the fibers thin and few. Clinically there is atrophy of the extremities, fairly symmetrical. The spread indicates branching of the nerve trunk. Fibrillary twitchings are not observed; the reaction of degeneration is frequent. Déjerine is of the opinion, because of these findings, that tabes at times locates in the peripheral motor nerves. It has not as yet been proved that this is due solely to tabes. The clinical and pathologic findings are the same whether the neuritis is due to poisoning or to a mechanical injury. It has been known for a long time that in tabes, as in alcoholism, the motor nerves are vulnerable. Any toxin which a normal person can withstand may injure the nerves of an alcoholic or a tabetic person. Leyden, Remark, Möbius and others are of the opinion that in tabes there is a tendency to paralysis because through the degeneration of the posterior roots the impulses do not reach the anterior horn cells. The resistance of these cells is decreased, and they are easily injured.

A further objection to the theory of Déjerine is that in his studies he used the older methods of staining, and the author believes that the newer methods, especially the cell stains (Nissl's), are necessary to determine the entire picture, especially as regards the anterior horn cells. Lapinsky himself found no changes with the older staining methods, but he found them with the newer ones. The author also opposes the newer views of Déjerine that the changes in the anterior horn cells are the result of axonal degeneration and closes his discussion by stating that there are no good grounds for blaming these changes in tabes on a "tabetic" neuritis. Lapinsky is the leading exponent of the theory that the change is primarily in the anterior horn cells. With Nissl's stain he found in serial sections these changes in the cells: the cells were swollen, the Nissl bodies in part grouped around the nucleus. The nuclei were likewise swollen and altered in their shape and sometimes peripherally placed. Various peripheral nerves and muscles showed degenerative changes which had their origin in these cells. Clinically there were various differences from the neuritis of Déjerine. The localization of the atrophy does not indicate a distribution of the nerve trunks since some muscles were only in part atrophied, and in the same muscle normal bundles were found near the involved ones. There was no symmetry in the affected muscles. The patient first noticed the diminution in size. Fibrillary twitchings were not observed.

Joffroy thinks the cause of the foot deformity was pressure of the bed-covers, while Déjerine and Marie believe the atrophy of the leg muscles, which results from the tabetic neuritis, to be the underlying cause. Marie also believes that trophic disturbances in the ligamentous apparatus of the joints result. According to the author, the pressure of the bed-clothes was not the cause. In tabes, as in all atrophies, we must look for the point of attack for the toxin in the anterior roots or in the anterior horn cells. This injury and, as a result, degeneration of the peripheral nerve, causes an atrophy of the leg muscles. Some parts of the muscles remain unimpaired because not all nerve fibers or cells are involved. Therefore there is only a quantitative reduction in the electrical excitability.

The author concludes that muscle atrophy in tabes occurs under these conditions: (1) accompanying disease; (2) as a result of general weakness and anesthesia of the muscles toward the end of the disease; (3) as a result of peripheral neuritis—brought out, not through the poison of tabes, but through other injurious processes; (4) as a result of the localization of the specific trouble of tabes in the nerve roots and anterior horn cells, whereby the motor impulses are more or less interrupted.

Winkelman, Philadelphia.

EPIDEMIC ENCEPHALITIS. G. Mingazzini, Ztschr. f. d. ges. Neurol. u. Psychiat., O. **63**:199, 1921.

"Non sunt multiplicanda entia sine necessitate" is the text of Mingazzini's excellent article on epidemic encephalitis. From his own clinical experience in more than a hundred cases, reinforced by necropsy findings in a large number, together with a well chosen and extensive review of the literature, he has constructed an article that is a credit to Italian investigators. He considers the disease a definite clinical entity that should not be clouded by the description of multitudinous "types," and he discountenances the terms "epidemic myoclonus" and "lethargic encephalitis." He divides the acute manifestations into three phases: the prodromal, the hyperkinetic and the lethargic phases. Often the sequence is observed, although the hyperkinetic phase may be absent, as was frequently the case in the earlier cases reported, or it may be the dominating feature of the individual case.

The author characterizes the lethargic phase as a pseudostupor and not a true coma, for in this period there are frequently hallucinations of sight and hearing. These are without the affect reaction which is so characteristic of alcoholic delirium, the patient pointing out the flies, mice, snakes, etc., as though they were of ordinary occurrence and not to be feared. Disorientation is usually pronounced. Occupational deliria are of common occurrence. The patient shows no interest in the future and has no insight. Catatonia, flexibilitas cerea and catalepsy are often encountered as motor anomalies of the lethargic phase.

The disease subsides by lysis. Where the hyperkinetic phase has been pronounced, the metamorphosis to the lethargic phase may be abrupt, but the recovery from the lethargy is usually slow and a post-encephalitic condition often remains that proves very obstinate and slow in disappearing. Among the most frequent of these sequelae, the author notes adynamia and apathy, which may be sufficiently pronounced to term them neurasthenia or even melancholia. Often there are pains in the limbs, especially on movement, and muscular jerkings. Mannerisms may be observed. Another frequent sequel is agrypnia or inverted sleep rhythm. The parkinsonian syndrome is of frequent occurrence as a post-encephalitic complication, a large number of cases having been observed. Sometimes the disease begins with this syndrome, with a later onset of muscular jerkings and delirium.

An important statement of Mingazzini's concerning the occurrence of hemipareses in encephalitis is: "I have never seen a hemiparesis caused by a lesion of the internal capsule." He states that when weakness existed it was of slow onset and could always be explained by radiculitis. He lays much emphasis on the occurrence of radiculitis, both clinically and pathologically. Some of his arguments are worth stating: Pain and clonic jerkings are due to those diseases which exert pressure on the roots, and do not appear typically in poliomyelitis, syringomyelia or myelitis where the nervous substance is itself attacked. Herpes zoster has been observed, and exaggerated response to the galvanic current. Hiccup is said to be due to radicular irritation. Moreover, in sections of spinal cord there are to be seen extensive infiltrations of the spinal roots by lymphocytes, and the roots themselves are more or less compressed by them, as can be seen in the sections.

The author does not deny, however, that there is an inflammation of the gray matter of the spinal cord, for he refers to von Economo's findings, and he believes that paralysis of isolated muscles, such as the serratus anterior, may be due to this cause. Concerning paralysis of the ocular muscles also, the stand is taken that it is inflammation of the nucleus itself that causes the paralysis, and the author has prepared sections in which, for instance, the principal nucleus of the oculomotor group was pressed on by a large perivascular collar of lymphocytes. He states that he has never seen ophthalmoplegia in epidemic encephalitis. Rigidity of the pupils is a common affair, but subsides. The fact that one or the other of the divisions of the facial nerve may be affected speaks also for inflammation in the immediate vicinity of the facial nucleus.

The author takes up the consideration of the lethargy rather fully. Some investigators, he says, locate the sleep center in the floor of the aqueduct in close association with the eye muscle nuclei, so that oculomotor paralysis and somnolence often appear in common, but Mingazzini points out that tumors may involve this area and produce very definite paralysis without leading to lethargy. Fragnito, following Nonne, as a result of studies of the condition in lesions of this area, has termed the center the waking center, "Zentrum des Wachens," rather than "Schlafzentrum." Fragnito is against this conception, however, and places the center rather in the midbrain. Kennedy and Flexner believed that lesions of the thalamus, by blocking sensory impulses on their way to the higher centers, could cause somnolence, but here again, when much of the thalamus is destroyed, the author asserts that lethargy is not a characteristic finding. Barbara puts the whole question on an endocrine basis, there being excito-anabolic and excito-katabolic hormones which, secreted by the endocrine glands, act on the sympathetic system with resulting wakefulness or sleepiness. A disturbance of the balance will bring about disturbances of sleep mechanism. Mingazzini prefers, however, to base the symptoms on the pathologic findings, and in so doing follows the opinion that parenchymatous inflammation of the basal ganglions will give rise to somnolence. This is in accord with the frequency of other signs of basal ganglion disease, paralysis agitans, tremor, pain of a cerebral nature and indications of extrapyramidal disease.

For differential diagnosis he takes up only poliomyelitis and influenza, and shows clinically, experimentally and pathologically that epidemic encephalitis is different from either of these, although having some characteristics in common with both. The diagnosis can no longer rest, he states, on the triad—lethargy, fever and paralysis of the extra-ocular muscles—but the disease must be considered pathologically. It can affect either cranial nerves, or spinal nerves, especially the nerve roots; it can affect at one time the spinal cord substance, at another the brain, especially the brain-stem and basal ganglions, or it may localize about the ramifications of the basilar artery or the branches of the sylvian artery. If the pathology of the disease is understood, the diagnosis will be more satisfactory, and multiplication of types will be avoided.

In closing, concerning the treatment, he states that while some men have found intragluteal injections of milk or horse serum to be efficient against excitement, he has had the best results in treating the disease as a whole from the use of baths, leeches against the mastoid processes, small doses of bromids and milk diet. The subsequent apathy and "parkinsonoid" symptoms he manages with the best of hygienic treatment over the necessary period of months.

Freeman, Philadelphia.

A FEW REMARKS ON THE INSTITUTIONAL TREATMENT OF SCHIZOPHRENIA. A. **Repond**, Schweiz. Arch. f. Neurol. u. Psychiat. **8**:190-199, 1921.

The possibility of instituting useful therapy in schizophrenia occurred to the author following a comment, by Bleuler, on the remark of a pupil, that so many of these patients had to be fed by means of a tube. He said, "It is your fault alone that these patients do not eat spontaneously." Following this rejoinder, the apathy of the attending personnel was so much improved that all but one of these schizophrenic patients were brought to eat spontaneously and developed a very hearty appetite within a few days. Since that time, whenever the condition of one of these patients not only ceases to improve, but tends to get worse, an attempt is made to discover what error on the part of the physicians and nurses was responsible for this change, and it is rare that some explanation, although it may be slight, cannot be found. He cites an example: A young catatonic woman with decidedly negativistic tendencies, but otherwise amenable to suggestions, permitted something to drop from her hand, apparently on purpose, and in very imperious tones demanded that it be picked up. This was not done. She immediately became absolutely hostile and until the date of her discharge, several months later, she did not speak. Another patient, the member of a titled Russian family, was offended because he had been addressed in a tone that seemed somewhat too familiar. Through the father, a plea was directed to the patient, and in this manner the attending personnel again ingratiated themselves, with marked amelioration of the patient's symptoms.

It has been a rather striking observation of the author's that in certain religious sanatoriums most of the schizophrenic patients fall asleep and become autistic. The writer looks on schizophrenia, from a practical standpoint, as resembling the psychic reactions of patients suffering from a cerebral injury, particularly when the post-traumatic manifestations are fluctuating, and when psychotherapy can accomplish such marked results. In the insidious forms this is not so well marked. In some of the latter cases Repond thinks he has obtained excellent results by the administration of sodium nucleinate injections. He cites the following case: J. P., 21 years of age, was a sufferer from enuresis until 18 years of age. He normally drank well, and was very affectionate. Suddenly one day, he left his work and declared that he could no longer work because he was becoming too old. He refused to eat for the same reason and would not drink milk because it came from beasts with horns, which reminded him of the devil. In fact, at the institution, he refused all forms of nourishment, since he observed that all people who ate had a glassy stare, while his expression was frank and clear. He had to be tube fed, remained absolutely immobile with his eyes closed, refused to speak, and did not react to any form of excitation. Given 0.5 gm. (7.7 grains) of sodium nucleinate, his temperature rose, and the next day he ate spontaneously and answered questions. Thereafter he again became negativistic and refused to leave his bed until another injection of 1 gm. (15.4 grains) of sodium nucleinate was given. Following this his attitude again changed, so that the next day he was happy and enjoyed playing the harmonica. These injections were continued, and the patient has been at home for a period of four years, perfectly well.

In schizophrenics having melancholic syndromes the writer resorts to subcutaneous injections of oxygen. Alterations in the circulatory system are treated with injections of epinephrin.

Following Bleuler's advice, he thinks it important not to institute any form of therapy that may be too vexatious to a negativistic patient. The application of therapy must be undertaken with tact, with a definite purpose in mind, and at the proper time. He believes that this can be done only when the patient and the physician have established a friendly relationship; then it is possible to decide on measures to be adopted. If no indication can be found, it is necessary to employ certain procedures as a test, for example, suddenly taking the patient out of a continuous bath or out of an isolated room for a walk in the open. The desires of the patient must be taken into consideration. He cites an interesting case in this connection: The patient was an old nurse who had for two months been in an acute catatonic crisis. She isolated herself, cried and assumed very threatening attitudes toward the staff. One day, however, there was immediate need for a nurse to serve at night. As an experiment, the patient was abruptly asked whether she would accept this position. The reaction was intense and the patient immediately became frank, thanked the physician, and that night, under observation, rendered excellent service. This surveillance, however, was not necessary, as further experience showed. She was devoted in her work and made interesting observations. In the morning, however, just as soon as she removed her habiliment she suddenly became catatonic, demanded that she be isolated or else hid herself, and would not sleep except by means of narcotics. Toward nightfall she became calm and at the prescribed time resumed her occupation. This was continued for a considerable period of time.

The task, accordingly, is to find a favorable opportunity to break into the autism of the schizophrenic. The best way of doing this is by instituting some form of work. This must not be too mechanical or schematic but must represent an occupation to which the individuality of the patient is adapted. It is also important that the rules of a sanatorium be sufficiently elastic not to impose too great a restriction on the patient.

It seems paradoxic that the dismissal of the patient from the institution can sometimes be used as a therapeutic measure. Repond has seen some excellent results follow immediately after dismissal, even when carried out against the wishes of the relatives. He thinks that this is important, particularly as it applies to the larger state institutions in which residence represents little more than room and board at public expense.

Woltman, Rochester, Minn.

FURTHER COMMUNICATION CONCERNING THE PECULIAR INCLUSIONS IN THE GANGLION CELLS OF CORPORA AMYLACEA IN AN UNDOUBTED CASE OF PARAMYOCLONUS MULTIPLEX.

A. **Westphal** and F. **Sioli**, Arch. f. Psychiat. u. Nervenkrankh. **63**: 215, 1921.

The case on which this article is based was reported in brief by Westphal a short time ago (*Arch. f. Psychiat.* **60**: Nos. 2 and 3). A boy, aged 18 years, with a negative family history, said to have had his first convulsion at the age of 10, some time after an attack of scarlet fever began to have myoclonic spasms and epileptic attacks which attained marked intensity and severity. The myoclonic spasms involved the entire voluntary body musculature, were quick and lightning like, with disturbances of motion. There was gradual mental deterioration. He soon became blind and deaf and the amblyopia increased without positive findings in the optic apparatus. Sometimes he had visual hallucinations. At times the pupils did not react; at other times they reacted sluggishly to light, the reaction being either one-sided or bilateral. There was likewise fluctuation in the skin and deep reflexes. The Babinski and Oppenheim reflexes were also variable, being weak or absent. These changes were evidently connected with the epileptic attacks. The gait was reeling, uncertain and cerebellar. His manner of speaking was changeable, being slow and scanning at times. All laboratory work was negative. In the last stages there was undoubted myoclonic reaction. Death occurred, nine years after the appearance of the first symptoms, in extreme dementia with difficult speech.

The brain weighed 1,330 gm. and no gross changes were noted. The brain was cut through the middle, the left half placed in 96 per cent. alcohol and the right half in liquor formaldehydi. After fixation there was seen in the left cerebellum a peculiar localized change in the medullary layer beginning in the region of the dentate nucleus. The white matter was colored a yellowish-brown without disturbance in the consistency. A detailed and complete study was made of the various parts of the brain by every conceivable stain, and this summary is given of the findings: "All parts of the central nervous system were studied and were not found atrophied. In the vessels was found neither infiltration nor disease. In the entire brain there was a slight increase of glia cells and fibers, especially in the outer layers, and some pigment was found in the vessel sheaths. Lipoid was seen in the ganglion cells. The case is distinguished by peculiar deposits, especially in the gray matter, and these can be divided into two groups: (1) corpora amylacea, most of which lie within the ganglion cells, and (2) glycogen-like granules, most of which lie extracellular. These deposits are found all over, but are more numerous in certain places. The ganglion cells are altered in the entire brain. These changes are of various types and in portions very severe. The deposits and the severe ganglion cell disease are most marked in the thalamus, nucleus ruber and nucleus dentatus; the difference is so manifest that one must talk of an elective intense disease of these gray nuclei."

Then follows a classical discussion of the mechanism of these deposits and their exact composition with no definite conclusions. The authors discuss the conditions in which foreign material appears in the cells, such as lipoid pigment in senility, etc. They state that it is not clear whether the inclusions are primary and begin the cell disease, or whether they are secondary.

WINKELMAN, Philadelphia.

SYMPATHETIC PAINS. J. TINEL, Presse méd. **29**:263 (April 2) 1921.

War injuries have called attention to various traumatic causalgias and similar pains of sympathetic origin. Such pains are localized at the cutaneous end of a nerve, rather than along its course, and are much more severe over the peripheral part of a limb than at the wound level. Superficial irritation, especially dryness of the skin and contact with the air, is particularly distressing. Deep pressure is less so. Typically characteristic are the painful crises aroused by any lively emotion or sudden sensory stimulus.

Ordinarily there is no anesthesia, but rather hyperesthesia and no paralysis or change in electrical reactions. Trophic vasomotor signs are marked; usually vasodilatation—hot, red, and profusely sweating skin—is noted; rarely, vasoconstriction—cold, white, dry and squamous skin.

Any mixed or sensory nerve may be affected. The median and the internal popliteal are most liable; the ulnar and the sciatic trunk less so.

The disproportion between an insignificant lesion and intense symptoms is often striking. The hypothesis of their sympathetic origin rests on the following evidence: (1) the nerves most often affected are richest in sympathetic fibers; (2) the pains have a special sympathetic character comparable to the sensation of numbness after cold, especially to that of warming after numbness; (3) the distribution of the sympathetic symptoms is often quite different from the distribution of the nerve trunk affected, and symptoms vary from day to day ; (4) persistence of causalgia is possible after section of the nerve apparently involved, while cures have been effected by section of the nerve below the wound or by periarterial sympathectomy; (5) referred pains often appear, extending either to other homolateral nerve distributions or to the same contralateral distribution, or to the whole of one side of the body.

Tinel concludes that a wound (generally slight) of a nerve trunk, either by the pain that it causes or by the irritation of sympathetic fibers that the peripheral nerve contains, can provoke a state of erethism or excitability of the corresponding sympathetic centers. This brings on not only the pains but also the vasomotor and secretory disturbances, and the extreme irritability of sympathetic terminations in the vicinity. Irritation of sympathetic centers can then progress to neighboring centers.

Symptoms following the irritation of wounds resemble those appearing in several different nontraumatic cases, which are fully described and compared. These symptoms are found in common:

1. Irritating rather than ordinarily painful sensations, often of agonizing degree and persistence; tension, fulness, numbness, intolerable heat, violent burning, momentarily helped by cold water, and associated often with arterial throbbing.
2. Absent disturbances of motion and sensation.
3. Irregular appearance of the sympathetic pains in paroxysmal exacerbations, and precipitated or exaggerated by emotion; also their progressive attenuation by physical and especially mental rest.

4. Progression and exaggeration of the pains in the absence of rest or satisfactory treatment.

5. Their limitation to predisposed subjects with irritable sympathetic nerve systems. Anxious states often accompany the pains either as cause or effect.

The mechanism of this sympathetic disorder is obscure even when a demonstrable point of irritation is present. Treatment is similarly unsatisfactory; surgery is apt to make matters worse; physiotherapy is unsuccessful, and of all the drugs that have been recommended Tinel has only found two that are at least occasionally of value—potassium iodid and calcium chlorid. He obtains best results from a combination of rest, mental hygiene and persuasion.

Huddleson, New York.

CONTRIBUTION TO PATHOLOGY OF THE THYMUS GLAND. 1. CHANGES IN GROWTH FOLLOWING THYMECTOMY. Eugen Bircher, Schweiz. Arch. f. Neurol. u. Psychiat. **8**:208-214, 1921.

Next to the thyroid the thymus gland has the greatest influence on the growth of bones. Basch was the first who attempted to remove the thymus experimentally and to note the results. The changes noted were confined mostly to the osseous system. The bones became generally much more pliable and frangible; the gait was awkward; the psychic reaction changed; callous formation following fracture was impaired. The long bones were most markedly involved, the ribs and hands less so. The epiphyseal lines were widened and irregular.

Matti and Klose noted relatively greater involvement in the posterior extremities, the formation of a rosary and spontaneous fractures following thymectomy in dogs. Matti attempted to identify these changes with those seen in rickets.

We know comparatively little of the after-effects of thymectomy in man. The attempt of Klose to establish a picture of idiotia or cachexia thymipriva has not as yet been successful.

The thymus is one of the few glands of internal secretion undergoing involution in post-fetal life. About the ninth month of life the thymus is firm and filled with secretion; from the third to the fourteenth year it is stationary in size; however, there is an increase of connective tissue and the secretions diminish quantitatively; from 25 to 50 years of age it diminishes in weight, and the secretion also becomes impaired qualitatively; complete disappearance usually does not take place.

There can now be little question as to the existence of the clinical picture of tracheostenosis thymica, the main symptom of which is dyspnea. Up to the present time several hundred such cases have been reported; however, only fifty patients have been operated on. The writer has had occasion to operate on ten such patients. In eight he had the privilege of examining the patients after intervals up to nine years. Complete removal of the thymus was not undertaken; indeed, it would be quite difficult on account of the aberrant thymus bodies. A subsequent examination showed rather convincing evidence of a delay in the appearance of the centers of ossification, allowing two years as the normal range of variation. This delay in some cases was found to be as great as six years.

While some of the cretinism seen in certain districts of Switzerland cannot be attributed to the disturbance of the thyroid gland alone, but, according to Holmgren, must represent an anthropologic variation, the latter interpretation does not seem to apply to these cases.

Bircher states that it is by no means necessary to remove the entire gland, but that removal of one fourth of it is enough to produce these changes. The diaphyseal lines in all cases were normal so that the writer does not feel that these changes can be explained on a rachitic basis. In two cases there was a deformity in the navicular and calcaneus bones of the feet, in which the former were seen to be small, irregular, and ragged in outline, while the latter were large but also irregular in contour. In these two cases there was a psychic factor, as evidenced by apathy, indifference and difficult progress in school.

In concluding, Bircher indicates that thymectomy must not be lightly considered and that radiation of the whole organ by means of the roentgen ray is to be discouraged.

Woltman, Rochester, Minn.

ETIOLOGY AND THERAPY OF MULTIPLE SCLEROSIS. Fritz Kalberlah, Berl. klin. Wchnschr. **58**:963 (Aug. 15) 1921.

According to Kalberlah, multiple sclerosis is the most common organic nervous disease with the exception of tabes and general paralysis. The apparent increase of the disease may be attributed to earlier diagnosis and to diagnosis on relatively fewer symptoms, such as transient eye palsies, passing scotomas, etc., in the absence of syphilis.

Strümpell's theories as to etiology have been abandoned. At present, following the work of Siemerling, Spielmeyer and others, the theory that the disease is due to an inflammatory change seems well founded. The pathologic picture is that of a hyperemia, infiltration of vessel walls and adjacent tissues with plasma cells and later destruction of the axis cylinders, disappearance of myelin sheaths and of ganglion cells, with focal changes in the meninges. Finally there is a glial proliferation with atrophy and shrinking of the brain and cord.

It is this pathologic picture which stimulated a search for an exogenous toxin. The work of Kuhn and Steiner in 1917, in which the disease was transmitted to rabbits and guinea-pigs and a spirochete isolated from the blood and liver of these animals, seemed to fulfil the prophesies of many.

It has been disappointing that other investigators have been unable to repeat the work of Kuhn and Steiner. The author, in 1920, obtained practically the same results as the earlier investigators. In support of his own findings he states that Siemerling, Büscher, and others, have been able to demonstrate a spirochete in fresh foci from cases of multiple sclerosis, but were unable to stain the organism.

The writer believes that the lack of corroboration makes it necessary to be cautious in drawing conclusions. He mentions the difficulty of staining spirochetes in the brain and the numerous errors made in calling nerve tissue spirochetes. Kalberlah believes that one is justified in saying that multiple sclerosis is in all probability an infectious disease due to a spirochete.

Since 1918 Kalberlah has used silver arsphenamin in the treatment of thirty-six patients suffering with multiple sclerosis. The results have been favorable though no cures have been effected. Patients with mental symptoms have shown the least improvement. Similar results have been reported by other observers in Germany. The writer does not think that arsphenamin is the ideal remedy, but up to date it presents the best agent, having in the arsphenamin an antispirochetal effect and in the silver a special affinity for nerve tissue. The method of use is described, being essentially the same as that employed in tabes. Special emphasis is placed on continued treatment.

Because of the pathology of multiple sclerosis it is of the utmost importance to make an early diagnosis as in chronic cases with glial changes little can be hoped for. However, in these cases treatment should also be instituted as it is of value in warding off new foci, even if the old lesions cannot be affected. In the chronic cases little may be accomplished because of the extensive destruction which has already taken place.

In conclusion the writer insists that once the treatment with silver arsphenamin has been started, it should be continued intermittently for years, as in tabes, even though the improvement is slight, and it is essential that one does not become discouraged quickly.

Moersch, Rochester, Minn.

HYPOPHYSEAL SYNDROME OCCURRING WITH TUMOR OF THE THIRD VENTRICLE WITHOUT HYPOPHYSEAL INVOLVEMENT.

P. Lereboullet, J. Mouzon and J. Cathala, Rev. neurol. **28**:154 (Feb.) 1921.

The protocol in the authors' case may be summarized thus: The family history was negative except for evidence of neurosyphilis (type unspecified) in the father. The patient was a young man, aged 26, presenting what was considered clinically as a typical Fröhlich syndrome: segmental adiposity, hypotrichosis, delicate texture of the skin, genu valgum and gonadal hypoplasia, with apparent absence of libido. In addition, severe cephalgia, attacks of vomiting, and diplopia, with diminished visual acuity, were reported, dating from the age of 17. At 20, vision was found to have been completely lost in the right eye and temporal hemianopsia was determined in the left. Roentgenologic examination of the sella turcica was negative until the age of 25 when evidence of excessive calcification was found in the region of the clinoids. Neuropsychiatric examination at this time was apparently negative, and no further physical deviation was observed. Examination of the spinal fluid showed evidence of slight lymphocytosis (15) and increased solids, although these abnormalities were not uniformly present on subsequent examinations. On the occasion of the last spinal fluid examination (just before death) the Wassermann reaction was found to be positive, although the blood Wassermann reaction was negative; no mention is made of the colloidal gold reaction or of the character of previous blood and fluid Wassermann reactions.

On final presentation at the authors' clinic (when the patient was 26 years of age), there was reported definite exacerbation of the patient's complaints as noted: severe headache, attacks of vomiting, impaired vision and extreme weakness. Shortly following this, bradycardia was observed, and the patient passed into a state of progressively more marked somnolence, which was characterized, at times, by delirium and which terminated finally in death, having been immediately preceded by coma, marked by mydriasis, strabismus, a bilateral Babinski sign, partial rigidity and incontinence.

At necropsy there was found a cystic papillomatous epithelioma, showing areas of calcification and apparently primary in the third ventricle, but extending basally into the interpeduncular space, encroaching on the optic chiasm anteriorly, compressing the infundibular stalk and extensively involving the mamillary tubercles and the gray matter of the anterior perforated space, with some displacement of the cerebral peduncles posteriorly. The pituitary body, aside from the compression of the infundibular stalk, as described, showed no evidence of pathologic alteration, nor was there indication of disturbance histopathologically in any of the other endocrine bodies with the exception, perhaps, of a certain degree of orchitic sclerosis.

In view of the very definite picture of the Fröhlich syndrome presented clinically, the authors are struck by the apparent absence of endocrine involvement, particularly hypophyseal, and suggest, in explanation, the possible relation of the determined compression of the infundibular stalk. They also feel that their case may serve to throw some light on the hypothesis recently advanced as to the possible directing influence of the tuber cinereum and the basal gray matter (involved in this case) on sexual development and the production of somnolent or torporous states. Of especial interest in connection with the present case is the report recently made by Claude and Schoeffer (Tumor of the Third Ventricle with Compression of the Hypophysis but Without Hypophyseal Syndrome, *Rev. neurol.* **28**:25 [Jan.] 1921) of a large third ventricle tumor involving the sella turcica, with severe pressure atrophy of the entire pituitary body, particularly the posterior lobe, and inferentially the infundibular stalk, unattended, however, by any clinical evidence of the so-called hypophyseal syndrome.

Raphael, Ann Arbor, Mich.

COMPULSION AND DEPRESSION, A CLINICAL STUDY. Beck, Monatschr. f. Neurol. u. Psychiat. 48:273 (Dec.) 1920.

According to Westphal, the criteria of a compulsive idea are that it develop in the mind of a person whose intellect is unimpaired; that it be not determined by feeling or emotion; that it force itself into the consciousness of the person against his will, and remain in spite of his efforts to displace it; that it prevent the normal flow of ideas; that it be appreciated by the patient as something foreign to himself. Four points are essential to the fulfilment of Westphal's definition:

1. The intellect must be intact.
2. The compulsive thought cannot be displaced and must impede the normal flow of ideas.
3. The thought must not be caused by affective factors.
4. The patient must have insight.

The author accepts the first two of Westphal's criteria, and devotes his paper to an attempt to demonstrate by case reports that affectivity plays a definite rôle in compulsion processes and that insight is not always complete.

Whereas there are undoubted cases which come entirely within the scope of Westphal's definition, there are many more in which a definite relationship—even a causal relationship—may be shown between compulsion process and emotional disturbance. So closely is the whole group of compulsion neuroses related to the manic-depressive group that difficulties of diagnosis are constantly cropping up. All transition types occur, and the author, in common with many others, seriously doubts the feasibility of making a differential diagnosis between manic-depressive insanity and psychesthenia.

Summarizing, he states that the compulsion neuroses may occur independently; but in both the acute and chronic forms they may be intimately associated with manic-depressive insanity; compulsion neuroses may run the same type of course as manic-depressive insanity, and in many cases emotion is the cause of the development or progress of the symptoms. In some cases, insight into the content of the compulsive thoughts is lost. Differential diagnosis between the two groups leads to numerous difficulties—both in acute phases and in the constitutional types. The more intensively one studies such persons, the more firmly is one convinced that a grouping into the ordinary diseases is impossible. We may label such a patient as having a degenerative constitution, or as a psychasthenic or manic-depressive—but this means little; it is only by an intimate study of each patient that we can understand him, and it is that understanding and not classification that counts. The author then gives a table showing the relationship between the various types of disturbed emotional life.

Selling, Portland, Ore.

PARALYSIS IN CHILDREN DUE TO THE BITE OF WOOD-TICKS.

P. D. McCornack, J. A. M. A. **77**:260 (July 23) 1921.

The author reviews the literature dealing with paralysis in children and adults resulting from the bite of wood-ticks (*Dermacentor venustus*). This animal is also responsible for the transmission of Rocky Mountain spotted fever. Its bite causes "paresis, paralysis and, in some cases, death." A similar syndrome has been found in sheep to which it has been found attached. Adults are rarely affected. It is interesting that among sheep the yearlings alone become ill; the older sheep apparently acquire immunity.

The tick season may begin "as early as February and last until August." Southern British Columbia, eastern Washington and Oregon, Idaho and Montana are the usual localities. Cases are also reported from Cape Colony and Australia.

Both in sheep and man, more than one tick may be found, but the increase in number does not seem to influence the severity of the disease. It has been produced experimentally in sheep by the attachment of the tick, but the disease has not been transmitted from a sick animal to a well animal by inoculation of material from the central nervous system. The paralysis may clear up before removal of the tick. No definite pathology except slight congestion of the brain and spinal cord has been found in animals dying from this form of paralysis.

"The symptoms are usually characterized by the sudden onset, in a previously healthy child, of weakness in the muscles of the extremities, staggering, difficulty in standing, and disinclination to active play, rapidly followed, in a few hours, by more or less complete motor paralysis. The child is often unable to stand, hold the head erect, or feed himself, although consciousness is not impaired. The onset may be accompanied with convulsions. The incubation period in children is doubtful, but, by experiments in animals, it is found to be from six to seven days after the ticks are attached. Rapid pulse and a slight rise of temperature have been noted. A large engorged wood-tick is found somewhere on the body, most often in the scalp, occasionally in the external ear, the axilla and other protected areas."

The prognosis is good when the tick is removed early. The patient's recovery may be looked for in forty-eight hours. When the paralysis has become extensive death may follow from respiratory failure. The disease may be confused with polio-encephalo-myelitis, meningitis or an acute intestinal intoxication.

In one case a blood examination revealed eosinophilia. The treatment consists in removal of the tick. Great care must be exercised to remove its head.

Kraus, New York.

A REVIEW OF A YEAR'S SERIES OF INTRACRANIAL TUMORS.

C. E. Locke, Jr., Arch. Surg. **3**:560 (Nov.) 1921.

In this review, Locke reports 255 cases with the presumptive diagnosis of brain tumor that occurred in Cushing's clinic during twelve months. Of this number, 107 were verified brain tumors, 60 unverified, 56 brain tumor suspects, and 32 belonged to the nontumor group. There were in all 180 operations performed and 20 fatalities. This is a creditable showing, and reports such as these are useful in that they serve to strengthen the growing conviction that the results of such surgery are already within reasonable limits of expectation. Such reports also serve to strengthen the belief that cranial exploration should be resorted to more frequently. There is no more reason for hesitating to carry out an exploration of the brain or spinal cord on justifiable symptoms than there is to hesitate to explore the abdomen, provided the exploration is done by one qualified to do it. Forty-two and one-half per cent. of the total number of tumors belonged to the glioma group, and, as the author states, these figures are in keeping with the general idea that gliomas are the most frequent tumors of the brain, constituting from 40 to 50 per cent. of all intracranial tumors. What is not so generally known, however, or rather, appreciated, is the fact that much can be done by surgery in this group to prolong life. Occasionally, even a solid glioma can be removed. Gliomatous cysts can be drained, and, if in a favorable location, sometimes removed. There were sixteen gliomatous cysts out of a total of forty-five gliomas in this series. The cerebellum was the usual location and 73 per cent. occurred in children. This report is well worth reading in the original.

Rodman, Philadelphia.

EARLY CONTRACTURES OF REFLEX ORIGIN—THE HORMETONIC SYNDROME. S. Davidenkof, Rev. Neurol. **27**:9 (Jan.) 1920.

Davidenkof proposes the term hormetonic (*ἡ ὁρμή* -stroke; *ὁ τόνος* -tension) syndrome, in designation of the early tonic hyperkinesias frequently noted in the paralytic field in encephalitic disturbance, particularly where associated with coma, such as the various cerebrovascular accidents, encephalomalacia, brain abscess, cranial injuries, attended by crushing of cerebral tissue, and the encephalitides.

This syndrome, which may vary greatly in degree, and which has been regarded by most observers as a manifestation of pyramidal irritation, becomes evident as a rule, from one to three days after the onset of paralysis. It is characterized primarily by intermittent muscular rigidity in the zone of paralysis (occasionally other areas may become involved), marked by fixed attitudes or contracture-states, interrupted at intervals by involuntary tonic movements. The reflex of defense is definitely exaggerated, and is characterized by the same movement-components as compose the involuntary tonic spasms. The condition is essentially transitory, and tends to disappear gradually in parallel with the abatement of coma, although in rapidly progressive cases it is generally found to persist until death occurs. These early or "precocious" contracture-states may, or may not, be later succeeded by permanent paralytic fixations.

Raphael, Ann Arbor, Mich.

THE ACHIEVEMENTS AND LIMITATIONS OF NEUROLOGIC SURGERY. Charles H. Frazier, Arch. Surg. **3**:543 (Nov.) 1921.

In this address, Dr. Frazier expresses his views on neurologic surgery, which have grown out of his large experience. He is one of the very few whose experience is sufficiently great in this line of work always to justify a respectful hearing. When coupled to this is the well-known discrimination which Dr. Frazier brings to his work, one can safely follow his lead. The address discusses in turn certain facts in the comparatively recent history of this specialty in surgery, types of tumor and their treatment, pseudotumors (so-called), subtemporal decompression, major trigeminal neuralgias, surgery of the pituitary body, tumors of the spinal cord, surgery of the spinal roots, chordotomy for the relief of pain and certain matters of technic. It was interesting to the reviewer to read Dr. Frazier's opinion of the intravenous use of saturated salt solution to control increased intracranial pressure (Weed and McKibben), as he had the impression that this was already proving to be a useful procedure. In the light of the opinion expressed in this review, however, it apparently is a procedure to be used with caution. All of those interested in neurologic surgery should read this address of Dr. Frazier's, which so authoritatively discusses the subjects mentioned.

Rodman, Philadelphia.

NEW OBSERVATION CONCERNING THE PATHOGENY OF A NEW SYMPTOM OF MENINGITIS. G. R. Lafora, Rev. de méd. **38**:366, (June) 1921.

In 1915, the writer first pointed out a symptom in meningitis, not previously described, namely, nasal itching, dependent, in his opinion, on irritation of the trigeminal branches or of its ganglion. The nasal mucous membrane has sensory ennervation from four trigeminal branches: (1) an internal nasal nerve, branch of the ophthalmic, (2) sphenophalatine nerves, branches from Meckle's ganglion, (3) posterior nasal nerve, a branch from the posterior palatal, and (4) the ptergopalatine, a posterior branch from Meckel's ganglion.

Basilar meningitis often causes an inflammatory encasement and toxic irritation of the gasserian ganglions, and this can extend along the nerves mentioned. It is an irritation phenomenon akin to the development of convulsions in cases of helminthiasis.

The patient reacts to the itching sensation by persistent scratching of the nose, and this behavior in meningitic cases may continue even into the period of semistupor. It is not an exclusive symptom of cerebrospinal meningitis but is seen in all types, including tuberculous meningitis and the post-otitic.

The writer reports a case in detail in which the symptom was present unilaterally.

Huddleson, New York.

TUMOR OF THE THIRD VENTRICLE WITH COMPRESSION OF THE HYPOPHYSIS BUT WITHOUT A HYPOPHYSEAL SYNDROME. H. Claude and H. Schoeffer, Rev. Neurol. **28**:25 (Jan.) 1921.

The protocol in Claude and Schoeffer's case may be summed up as follows: The patient, a toolmaker, aged 29, entered the authors' service complaining of severe headache, vomiting, failing vision, somnolence and general asthenia, dating back ten months, associated with a gain of 22 pounds in weight (apparently nonsegmental), sexual impotence and character change, marked particularly by extreme irritability and jealousy. Examination showed marked somnolence, diminished visual acuity with bilateral papilledema, retardation in the kinetic field, absence of abdominal reflex response, slight lateral nystagmus and a pulse rate of 60. Examination of the spinal fluid proved negative. Seventeen hours after admission the patient passed into a state of coma which lasted approximately an hour, in which were noted loss of corneal and pupillary response, anisocoria, rigidity over the entire right side and urinary incontinence. On the fifth day the Babinski sign was secured on the left and the pulse rate was found to have been reduced to 52 with marked deepening of the patient's torpor, associated with Cheyne-Stokes respiration. Decompression was performed the following day, the patient dying, however, some hours later without regaining consciousness.

At necropsy examination the third and lateral ventricles were found to be widely dilated and the former to contain a cyst about the size of a pigeon's egg. This was epitheliomatous in type and apparently of stomodeal origin, extending from the sellar space where it had produced marked atrophy of the hypophysis, particularly the posterior portion, although there was determinable no evidence of actual neoplastic invasion of this tissue, a feature which, in the authors' opinion, affords explanation of the definite absence, in this case, of the so-termed hypophyseal syndrome.

Raphael, Ann Arbor, Mich.

PERIPHERAL NEURITIS FOLLOWING MALARIA. Janusch, Ztschr. f. d. ges. Neurol. u. Psychol. **63**:123, 1921.

Janusch says that infection and intoxication are, of course, the principal factors in the causation of malarial peripheral neuritis, but that predisposing causes are exertion, exposure and undernutrition. Five personal cases are reported, occurring in soldiers in the Balkan campaign. The neuritis begins soon after the onset of the malaria, usually within two weeks. It affects the proximal groups of muscles of the extremities, and chiefly the shoulder muscles. In many cases the neuritis is limited to a single nerve, or even a single muscle. The occurrence of the disease in the muscles of the shoulder girdle has been laid to the unusual activity of these muscles brought about by carrying packs during the campaign. Paralyses are predominantly unilateral. Objective disturbances of sensation are uncommon, but there are often severe pains in the areas affected. There is a tendency to spontaneous recovery, but this is very slow, usually requiring about a year. The treatment is symptomatic and electrical. Quinin although curing the malaria, has no effect on the neuritis.

Freeman, Philadelphia.

PSEUDO-SYNDROME OF TAPIA. A. de Castro, Rev. Neurol. **27**:537 (June) 1920.

The author's case was that of a tabetic patient (a woman, aged 35) in whom manifestations of eleventh and twelfth cranial nerve palsies developed following self-inflicted laceration (suicidal) on the right side of the neck. Examination revealed sternocleidomastoid and trapezius palsies, a nasalized voice, right atrophy of the tongue with marked fissuring, tremor and deviation to the right on extension and bilateral paralysis of the adductors and abductors of the larynx. There were also evident signs of the tabetic series—typical lancinating pains in the legs, lost knee and ankle jerks, the Romberg sign, hypotonus of the lower extremities, ptosis of the left eyelid, right pupil of the Argyll Robertson type, and a positive Wassermann reaction.

De Castro comments on the resemblance of the findings determined in this case to those characteristic of the so-called Tapia syndrome (homolateral glosso-scapulo-laryngeal hemiplegia depending on eleventh and twelfth nerve disturbance). Of definite interest in this case was the presence of bilateral laryngoplegia, a distinct departure from the conventional Tapian picture, which (on the left) de Castro feels may well be syphilitic in basis and of central locus as opposed to the eleventh and twelfth nerve palsies on the right which seemed definitely peripheral in character, a feature particularly significant in view of the obscurity at present obtaining as regards the actual mechanisms involved in this syndrome.

RAPHAEL, Ann Arbor, Mich.

SPECIFIC TREATMENT OF DERMATITIS VENENATA (RHUS TOXICODENDRON). (PRELIMINARY REPORT.) ARTHUR SAYER, Med. Rec. **100**:717 (Oct.) 1921.

Eighteen case reports are given showing the results of treatment with tincture of *Rhus toxicodendron.* The tincture was prepared from the fluid extract as follows: fluid extract 2 parts, alcohol (95 per cent.) 9 parts, water 5 parts. An average dose of 12 minims was injected into the gluteal muscles. Twenty-five per cent. of cases showed immediate striking improvement; 25 per cent. more improved with one injection and were entirely relieved by a second injection. At least 75 per cent. of the cases were materially benefited. No local treatment was used in this series, but the author recommends the following to be used in conjunction with the injections: soap and water scrubbing at the onset, followed by an application of 1 : 1,000 potassium permanganate solution for five minutes, then calamine and zinc lotion every two or three hours.

TOMLINSON, Omaha.

ON THE PERMEABILITY OF THE CHOROID PLEXUS. A. BARBE, Rev. Neurol. **27**:314 (April) 1920.

Barbe carried out a series of carefully controlled perfusion experiments on the choroid plexi in a number of human subjects of various ages who had succumbed to various systemic and neuropsychiatric disorders. On the basis of this study the choroid was found to be most permeable to blood serum. Penetration of test fluids was noted to begin a few seconds following application, depending primarily on the freshness of the choroid material, the age of the subjects (seniles least permeable) and the absence of neuraxial disease. The actual rate of penetration through the choroid averaged approximately 1 c.c. per minute in normal subjects, remaining so for about twenty-four hours, after which alteration occurred as a result of postmortem changes. In certain conditions, notably general paresis (a finding of considerable therapeutic importance, if actually established) choroid permeability was found to be definitely increased, while in others, as in epilepsy, it was noted to be diminished.

RAPHAEL, Ann Arbor, Mich.

Society Transactions

BOSTON SOCIETY OF PSYCHIATRY AND NEUROLOGY

Regular Monthly Meeting, Oct. 20, 1921

James B. Ayer, M.D., *President, in the Chair*

THE SOMATIC ORIGIN OF CERTAIN SEXUAL DELUSIONS. Dr. J. W. Courtney.

Probably there is no delusional state more curious than the belief entertained by women that beings either human or supernatural have sexual intercourse with them during their sleep. According to the tenets of the oneirologic school of psychology, a delusion of this character is the product of an uneven conflict waged in the unconscious mind between erotic desires and moral inhibitions. The concept of it here propounded is based on fundamental physiologic principles—hence excludes the unscientific notion of an unconscious mind, since, obviously, mind cannot exist without some degree of consciousness.

When we trace to their origin those sensations whose summation is the sexual orgasm, we find that they are manifold and of several orders; tactual, muscular, visual, auditory, olfactory, thermal and so forth. As a result of the repetition of sexual congress at intervals over a certain period of time, these sensational elements become so strongly integrated and correlated that their resultant ideational and emotional complexes may easily be reproduced by stimuli, however indirectly applied, which evoke but a single one of the sensory elements enumerated—and that in so minor a degree of intensity that in its course along centripetal paths, it fails to reach the higher levels of consciousness.

With these physiologic facts in mind, the genesis of the delusion under consideration is manifest. In the sleep state tactual and thermal sensations initiated in the external genitalia by bed clothing, thermal sensations in the same parts aroused by the pelvic congestion of vasomotor origin which precedes menstruation, or the sensorimotor impulses sent direct to the clitoris by a full bladder through the medium of the pudic nerve, easily suffice to set in action the remainder of the group of integrated and correlated sensations, and these, according to the strength of their integration and correlation, determine the vividness of the ideational feeling of sexual congress to which, by sublimation in centers higher up, but still below the highest levels of consciousness, they give rise.

The concordance between the principles thus outlined and observed clinical phenomena is perfect. Where the deluded individual's experience with sexual congress is extensive, the dream coitus has an ideational content which embraces highly complex combinations—postural and dynamic—in the voluntary and involuntary muscular systems alike, intense tactual and thermal sensations and last, but not least, visual impressions of an order sufficiently vivid to give rise to the actual sight of a male figure, yet falling short, as a rule, of the degree of vividness necessary to identify this figure with that of a known person.

When the deluded person is virgo intacta and without personal sexual experience of any order or degree—when her knowledge of the male configuration has been derived through effigies, and of the procreative act by reading and hearsay, the sensational elements underlying her delusion are so feebly integrated and correlated that the story she tells of her defloration during sleep lacks utterly in circumstantiality and congruity.

In both instances, however, the ideas initiated by the sensational stimulus follow well-established physiologic laws as regards durability. Their tendency to endure is, to be sure, enhanced by the general erethism of the organism, which coexists. Be this as it may, they do in fact persist with such tenacity that the reasoning powers of the person's fully awakened consciousness are impotent to repress them. By their very persistence they soon dominate the mind as completely as if they were established facts—hence, readily excite its inferential activities.

In the case of the woman with actual experience of coitus these activities seldom go further than to lead her to the conclusion that the partner of her nocturnal sexual activities is a human being, whereas, in the case of virgo intacta without any personal knowledge of the procreative act, the conclusion arrived at is infinitely more complex. For the reasons already set forth, she cannot identify her ravisher even as a member of the human species—hence, through the religious exaltation of which she is generally also the victim, her distorted reasoning runs on supernatural agency, and she finally convinces herself not only that her dream defloration was brought about by such an agency, but that its accomplishment is of vast importance to the celestial hierarchy.

DISCUSSION

Dr. Stanley Cobb: If it were true that such dreams had a physiologic rather than a psychogenic origin, all women at certain times would have such dreams. There must be a psychogenic factor and a subconscious or unconscious cause aside from the physiologic. The physiologic and psychologic theories are not mutually exclusive.

Dr. J. W. Courtney: I do not consider the two theories mutually exclusive. I simply emphasize the physiologic as the dependable one, the one dictated by common sense. To exploit theories of pathogenesis in mental disorders, which in nowise conform to the laws underlying pathogenesis in general, seems to me highly illogical.

A PRELIMINARY REPORT ON THE TREATMENT OF PARALYSIS AGITANS. Dr. Hugo Mella.

Claude, Sicard, L'Hermitte, Quesnel and Rodriquez have reported excellent results with the use of sodium cacodylate in cases of spastic paraplegia and Parkinson's disease.

Stanley Cobb, at the Massachusetts General Hospital, gave sodium cacodylate in 0.5 gm. (7.71 grains) doses (intramuscularly) daily for ten days with no relief in two cases: one of paralysis agitans and one of amyotrophic lateral sclerosis. One patient with paralysis agitans showing marked tremor and moderate rigidity with pain had relief from the rigidity and pain, and the tremor diminished. At the Massachusetts General Hospital I gave it in one case of syphilis of the central nervous system with Parkinson's syndrome, and no amelioration of the tremors or rigidity was noted. One patient with rigid postencephalitic Parkinson's disease, after ten doses of 0.5 gm. (7.71 grains) and four of 1 gm. (15.43 grains) showed only slight relief from rigidity.

Another patient with a mild case of Parkinson's disease, after ten 0.5 gm. doses walked better, wrote better and could move her arms more freely. The results in ambulatory cases not being satisfactory, four advanced cases at the Long Island Hospital, Boston, were then chosen.

Case 1.—In this case rigidity commenced eighteen years ago. The patient was bedridden for the last year. She had tremor of the arms and legs which were markedly flexed and rigid. She could not feed herself or raise her arms. After the fourth dose of sodium cacodylate the patient could raise the right arm and feed herself.

Case 2.—Rigidity and tremors commenced twelve years ago. The patient was very rigid and could not raise his arms to the level of his shoulders. In April, 1921, ten doses of sodium cacodylate 0.5 gm. (7.71 grains) each were given with no relief. Then six doses of 1 gm. (15.43 grains) each were given after which the patient could raise his arms above his head, move more easily and showed only slight rigidity; but associated movements in rising from a chair and walking did not return. He has received no injections since that time and his condition is about the same as when treatment was discontinued.

Case 3.—The patient had been practically helpless for the last four years; she had to be lifted from the bed to the chair and could not feed herself; she had marked tremors and rigidity. After fifteen 0.5 gm. doses of sodium cacodylate in April, 1921, the patient could walk across the ward unaided, raise her arms above her head and feed herself. One course of ten doses has been given since then and the patient is still up and feeds herself.

Case 4.—Rigidity and tremors commenced four years ago. The patient had been confined to bed for eighteen months, practically helpless. In April, 1921, after eleven 0.5 gm. doses of sodium cacodylate, the patient was up, walking about the ward and able to feed herself, showing a slight tremor and only a moderate amount of rigidity.

A PRELIMINARY REPORT ON THE TREATMENT OF MYASTHENIA GRAVIS. Dr. Hugo Mella.

In the fall of 1920 a young lady was seen in the outpatient department of the Massachusetts General Hospital who showed the signs and gave the typical electrical reactions of well-developed and advanced myasthenia gravis. Just previous to this a patient under my care had died of this disease and necropsy showed a large, malignant, thymus gland. A roentgenogram of the case showed a rather large shadow in the thymus region. Roentgen-ray treatment was commenced by Dr. Holmes, under great precaution, in suberythema doses (the patient reacting severely). After seven such doses the patient was entirely relieved. She has been free of all signs of myasthenia gravis since April, 1921. Her electrical reactions are now normal. A complete report of this case is to be given when at least a year has elapsed after the disappearance of all signs of the disease.

DISCUSSION

Dr. Stanley Cobb: Our interest in these problems has been aroused by the work of the French authors mentioned. While the experience at the Massachusetts General Hospital has been somewhat unsatisfactory, those cases were all ambulatory cases. The most marked improvement has been in the cases at the Long Island Hospital in which there was often extreme rigidity of long standing. It seems certain that arsenic affects the rigidity of paralysis agitans in some way. Recent investigation in the Department of Neuropathology at the Harvard Medical School so far corresponds with the recent work of Wilson and Ramsay Hunt; that is, in all probability the pathology of rigidity and tremor lies in the basal ganglions.

Dr. A. S. Merrill: The diagnosis of enlarged thymus is not an easy one to make. Occasionally a shadow can be seen which can be attributed to nothing else, but the thymus generally is transparent and casts only a slight shadow. The thymus is known to be one of the most susceptible organs in the body to the effects of irradiation. Assuming that the patient's trouble is due to thymus hyperactivity, it would be quite logical to presume that irradiation of this gland would have some effect on the patient's condition.

Dr. Walter B. Swift: A year or two ago I proposed a series of exercises for the treatment of paralysis agitans. At that time I could not exactly estimate their value, but from fifteen or twenty additional cases I judge the improvement to be elimination of from 10 to 60 per cent. of the tremor. When a man can be made to hold his newspaper still so that he can read it, and when he does not require an hour or two to go to sleep, it would seem that the exercises are of some help. They are not a cure, and some cases do not respond. The trouble seems due physiologically to some lack of conscious sensorial control.

Dr. J. W. Courtney: In two necropsies of paralysis agitans cases made a number of years ago, the most striking thing observed was the apparent shrinkage of the cord in toto—apparently not over half its normal size. In one of these cases Dr. Thomas made serial sections through the entire cord and about all that was found were universal perivascular changes of no marked extent.

Dr. Mella, closing: There is a great difference of opinion as to whether the lesion of paralysis agitans is located in the globus pallidus (Ramsay Hunt) or in the locus niger (Trétiakoff). There are several structures sending impulses to the red nucleus, of which even the physiology is not clearly understood, much less the pathology.

The intravenous method could be used, but the intramuscular injection had been found to be simpler. Furthermore, the arsenic preparations are excreted rapidly when given intravenously, but much more slowly when given intramuscularly. It is also less painful than if given subcutaneously. Aseptic precautions are necessary.

A CASE OF SYRINGOMYELIA TREATED BY THE ROENTGEN RAY.

Dr. George Clymer.

In 1907, a series of cases of syringomyelia, treated by the roentgen ray, were reported by Beaugard and L'Hermitte. Their report was so encouraging that further observation seemed desirable. The present patient, a young woman, aged 24, single, has been under observation for a little over six years. The duration of the symptoms, when the patient was first seen, was about eighteen months. There was a history of weakness and atrophy of the right hand, disturbance of sensation, chiefly of heat and cold, and pains running from the spine into the right arm. Examination revealed an area of diminished sensation involving the inner aspect of the right arm and hand, extending to the back and chest, and also an area in the right thigh. A roentgenogram of the spine revealed bifurcation of the spines of the third and fourth cervical vertebrae, suggesting congenital developmental defect. Under roentgen-ray treatment the patient's symptoms have grown less, the pains have ceased, and she has held a secretarial position for three years. A recent careful examination revealed diminution in the area of sensory disturbance. There was no evidence of progress of the disease.

DISCUSSION

Dr. A. S. Merrill: The effect of the roentgen ray on cell tissue depends on its approach to the embryonic form, that is, cells approaching the embryonic type with active cell division are more susceptible to the roentgen ray. Assuming that this condition may be due to proliferation of neoplastic cells approaching the embryonic type, it is reasonable that they may be affected by the roentgen ray provided they can be reached by a proper dose. The patient of Dr. Clymer, on that theory, received treatment over the whole cervical and practically the whole dorsal cord. The irradiation was pushed to the limit of skin endurance. French authors are very optimistic in their statements. However, eleven months was the longest time a patient was followed. Dr. Clymer's patient had been under observation for over six years. Improvement began promptly after the first few applications, motor symptoms improving first. As might be reasonably assumed, there is a symptomatic residue probably due to destruction of certain nerve tracts. Several cases of fair duration have showed encouraging results. Dr. Clymer's patient was irradiated thoroughly over sixteen or seventeen areas from the upper cervical to the lower dorsal cord on either side. At that time the method of cross firing was used to pick out the objective point from different directions and get a multiple dose at the spot where the growth focused and also to avoid injuring the skin. The French authors state with perfect reason that the cord should be treated over the whole extent indicated by the most careful neurologic examination and, it may be added, then some. Another patient under treatment has given less encouragement. So far as can be seen, there is little change in the patient's condition. She has received a number of irradiations including only the cervical cord. It would be better if she could have further irradiation over more of the cord.

Dr. J. B. Ayer: A woman aged 27 was given roentgen-ray treatment beginning in 1919. She had a very weak, atrophic left hand and much difficulty in distinguishing heat and cold. Four months previous to her coming she had developed distinct weakness of the right hand. The history, therefore, indicated progression. The blood and spinal fluid Wassermann reaction were negative. She became worse in 1919 and developed paralysis of the left vocal cord. She was then given roentgen-ray treatments. From December, 1919, to June, 1921, she was given seventeen roentgen-ray exposures by Dr. Merrill. She showed no progression in that time. On the contrary, she felt much better. It seems possible that this case has been arrested although not much improved.

Dr. Clymer, closing: This is, at least, a form of treatment worth considering.

RESULTS OF A BRIEF NEUROPSYCHIATRIC EXAMINATION OF ONE THOUSAND ONE HUNDRED AND FORTY-ONE STUDENTS. Dr. Stanley Cobb.

In 1914 Dr. Roger I. Lee began the physical examination of students entering Harvard. The examination was necessarily brief; later he called in certain specialists to assist. He asked me to study "nervous instability" because of the common occurrence of neurotic symptoms. The results and the method of working on the problem follow:

First we picked out men who could give a past history of some neurotic condition; second, those who presented physical signs indicating a tendency to nervous instability; third, those who showed evidence of endocrinopathy. Then we followed up through the four years the men on whom primary observations had been made, in order to study their reactions to their problems. The correlation of these findings showed first the incidence of nervous instability. Eighty-eight of the 1,141 had a definite past history of some form of nervous instability, such as night terrors, sleep walking, stammering. This last trouble comprised 23 per cent. of the neurotic symptoms. A comparison was made of the physical findings in these eighty-eight men with those in men who had no such history. The pulse rate, vasomotor symptoms, knee reflex, posture, urine, blood pressure and the vegetative nervous system were studied. Of the 1,141 students only twenty-two showed a pathologic condition of the glands of internal secretion, and they did not have severe cases.

The work indicated these conclusions:

1. History is the best guide to nervous instability—family history, past history and present complaints.
2. In a fifteen minute examination it is impossible to obtain an accurate history, and freshmen have few well-defined problems.
3. Vasomotor instability was found somewhat more frequently in men with neurotic histories.
4. Tachycardia, blood pressure variation and dermographia are often found associated with each other and with exaggerated knee reflexes. Men with albuminuria are likely to show all these symptoms.
5. Endocrinopathy was rare, but the small number of cases discovered showed more symptoms referable to the vegetative nervous system and less neurotic history and acne.
6. In men with poor mechanical use of the body, tachycardia, sinus arrhythmia, high blood pressure and variable systolic pressure were more common.
7. The men with poor bodily mechanics passed better psychologic examinations than those with poor posture.

DISCUSSION

Dr. Lloyd T. Brown: The examinations were carried out at the end of the vacation when the men were in the pink of physical condition. In the literature it was possible to find no standard by which to judge what constituted good and bad bodily mechanics. Therefore, tracings were made of each man, and according to the appearance of these tracings four groups were made. About 740 men were examined.

In judging the posture, or bodily mechanics, four points were taken up: the position of the head, the position and shape of the chest and abdomen, their relation to each other, and lastly, the anteroposterior curves of the back. It was found that 7.5 per cent. fell in the A, or good bodily mechanics group; 12.5 per cent. in the B, or fairly good group; 55 per cent. in the bad bodily mechanics group, and 25 per cent. in the very bad bodily mechanics group. These men were all asked about the occurrence of backache. No man in the A or B groups had backaches; about 7 per cent. of the C group and 9 or 10 per cent. of the D group had had backache. Operation for appendicitis had been performed one and a half times as often in the C and D groups as in the A and B. Albuminuria was found in a considerable number of men. These were followed up with great care; seven of them had persistent or orthostatic albuminuria. Of these seven, one was in the C, the other six in the D group.

In judging the postures or the mechanics of the body, it is necessary to appreciate that there are very different types of individuals and no one standard for the human race, as a whole. Some people are naturally thin with long, thin bodies and will never grow fat. Others are short, stocky and tend to grow fat. Either of these two classes or the very large class that is half way between, may use their bodies very badly mechanically, so that it is necessary to judge all people from a standard which can apply to one particular person.

Bad bodily mechanics are common in children, associated with fatigue. For instance, a child 4½ years old, always a difficult child to feed, who was never really well, having many attacks of indigestion and constipation, was brought to an orthopedic surgeon because of acute attacks of extreme pain in one hip. Examination showed no organic disease of the hip, but the child used her body in an extremely faulty mechanical way. She was shown how to use her body properly and given a brace to relieve the fatigue. She recovered entirely from the hip trouble and the constipation and indigestion were improved. After two years she came back with the original symptoms. The postural work had been entirely given up. It was again begun under more strict supervision and at the present time the child is 16 years old and is well.

Such a case shows that it is necessary to recognize the faulty mechanical element as well as the fatigue element, and that the remedy for these conditions is education not only of the child, but of the parents; also that this education should be started when the child is very young. It should be a part of the curriculums of all schools, so that when adult life is reached the necessity for the individual to compensate for his poor bodily mechanics will not add one more element of fatigue.

PHILADELPHIA NEUROLOGICAL SOCIETY

Regular Meeting, Oct. 28, 1921

George Wilson, M.D., *President*

A PATIENT WITH MYELITIS AND NEURITIS. Presented by Dr. S. F. Gilpin.

The patient, an Italian woman, aged 31 years, was admitted to the Jefferson Hospital, April 16, 1921. Her chief complaint was loss of sensation and motion in the lower extremities. Her health had always been good and the past medical history was negative. She was married and had four children living and in good health and had had one miscarriage.

Her present trouble began April 1, 1921, with a sensation of coldness and numbness in the right foot. This improved slightly, then paresthesia started in the left foot and extended up to the waist line, and at the same time the right leg became involved in its entirety; all this occurred within one week. She then began to feel weak in the left leg and limped about for one week; then the left leg became entirely helpless and the right limb weak. Two weeks before admission she went to bed and in a few days both legs became helpless. She had no headache, did not vomit and was not dizzy; there was no impairment of vision and no pain. She had loss of control of both sphincters for ten days previous to admission.

Physical examination showed that the patient was well nourished and mentally clear. The pupils reacted normally to light and in accommodation; the cranial nerves were normal and the general examination was negative. The patellar reflexes were absent; there was no ankle clonus, but Babinski's sign was present on both sides. She was hyperesthetic to pressure over the shoulders, upper part of the chest, lower extremities and abdomen. There was complete loss of motion in the legs. An ulcer was present on the left thigh. Sensation was lost in both legs, and the patient complained of fulness in the abdomen, suggesting a girdle sensation. A roentgenogram of the spine showed no pathologic condition. Examination of blood and urine was negative, as was the Wassermann test of the blood. The spinal fluid was normal. The patient gradually improved so that in six months she was able to walk with support. The deep reflexes returned, the superficial reflexes were normal, and she regained perfect control of the bowels and bladder.

The diagnosis of acute transverse myelitis seemed to be correct, but she developed signs of multiple neuritis. Did she have both myelitis and neuritis? Can a patient with such marked symptoms of a transverse cord lesion recover, or has she a case of neuritis with unusual involvement of the sphincters? The patient appears to be recovering with no signs of a permanent cord lesion.

DISCUSSION

Dr. Charles K. Mills: The history of this case is suggestive of a neuromyelitis, from which the patient may largely recover, that is, from which she may make approximate recovery. It did not seem to have been a syphilitic case, although its origin was evidently due to an infection.

Dr. Francis X. Dercum: I regard the case as one primarily of transverse myelitis in which a multiple neuritis was present. I have nothing to add to the description given by Dr. Gilpin, with the exception of emphasizing the sensation described by the patient of a broad constricting band around the abdomen. The clinical picture was unusual, and the patient made an unusual recovery.

A CASE OF SYRINGOMYELIA. Presented by Dr. S. F. Gilpin.

The patient, a Russian miner, was admitted to the Jefferson Hospital, Sept. 14, 1921, complaining of loss of power and of motion in the right arm. The personal and the past medical history were negative.

Present Illness: Two months before observation he noticed a gradual weakening of his right shoulder and upper part of the arm. The arm felt heavy and weak, but he had no pain.

Physical Examination: He could not raise the right elbow above the level of his shoulder. The grip in the right hand was normal. The eyes, chest and abdomen were normal. The spine showed marked scoliosis. The patellar reflexes were increased, but there was no Babinski or clonus. The reflexes were diminished in the upper extremities. The muscles of the right shoulder girdle were atrophic. Sensation was normal except over the region of the shoulder girdle. In this area he was unable to differentiate between a blunt and a sharp object and did not recognize heat and cold. The blood Wassermann test and test of the urine were normal. The roentgen ray showed right lateral scoliosis of the dorsal vertebrae with a moderate amount of osteo-arthritic changes involving virtually all the dorsal vertebrae. The patient appeared to have a case of syringomyelia with fibrillary tremors in the atrophied muscles, and the large muscles of the shoulder girdle were the first muscles to show atrophy.

DISCUSSION

Dr. F. X. Dercum: This condition began, as far as could be determined, in the hand, as is commonly found in beginning syringomyelia. The interesting feature is that the sensory loss of pain and temperature follows the shoulder girdle where the wasting is at present most marked.

Dr. Charles S. Potts: It is worth considering whether the symptoms are not due to the so-called spondylose rhizomelique, which is nothing more than an arthritis of the vertebral joints. In the so-called von Bechterew type there are symptoms of cord disturbance, especially of the nerve roots, which might cause the symptoms present in this case. It would seem to be especially so in view of the fact that there are no evidences of involvement of the spinal cord itself.

Dr. William G. Spiller: I recently had a patient with syringomyelia of the scapulohumeral type in my service at the University Hospital. This type is uncommon. It is possible from the hypertrophic arthritis of the vertebral column mentioned by Dr. Gilpin that his case is one of pachymeningitis cervicalis hypertrophica of Charcot and Joffroy, which sometimes clinically resembles syringomyelia.

Dr. John H. W. Rhein: In 1908 I made a pathologic report of the nervous system in a case of spondylose rhizomelique in which there was degeneration of the spinal roots. I believe that the symptoms present in Dr. Gilpin's patient might be explained on the basis of degeneration of the roots as a result of pressure of the diseased bones of the spinal column.

A PATIENT WITH DYSTONIA MUSCULORUM DEFORMANS. Presented by Dr. N. S. Yawger.

The case was that of a man of Irish ancestry, 21 years of age, who appeared to have had some defect since birth. He was an eight months' baby; the labor was induced, difficult and instrumental. His weight at birth was 5 pounds, and for years he was unhealthy and always had peculiar movements. His teeth did not erupt until the seventh year; he did not creep until 14, and although since that time he has shown much improvement in his ability to get about, he has never been able to perform such definite movements as feeding himself. It is said that he could not hold his head erect until he was 10 years of age. Of recent years, except for constant, spontaneous movements, he has been fairly healthy and eats ravenously.

The family history was without interest except for the fact that the mother was only 4 feet and 7 inches in height and a maternal aunt was of the same stature. The mother had had nine pregnancies, three of which resulted in miscarriages; on account of her small pelvis, labor had always to be induced at the eighth month.

Physical examination revealed physical stigmas shown by the palatal arch which was narrow and shallow, by teeth that were prominent and by a converging insufficiency of the right eye. The patient could get to the erect position and stand unsupported for a few seconds. Attempts to walk caused a more or less violent struggle of his musculature. He could not walk alone for more than a half dozen steps, during which time he inclined backward and often fell. If he walked for any distance he followed along the side of a room, or he had to be strongly supported by at least one person. His indoor mode of progression was preferably on his hands and knees, and was accomplished through a series of almost springing movements. Most of his movements were made suddenly and when he attempted to do anything he appeared to take his muscles by surprise. The patient had a three-wheeled conveyance which he worked with his feet and guided with his hands, and though it seems almost incredible, he went about alone. The choreiform movements almost never ceased except when he was sleeping soundly; even the muscles of the head and face were involved. The muscle power was a little weak throughout and there was marked incoordination. The tendon reflexes were normal in the upper extremities but were slightly exaggerated at the knees and the ankles. Ankle clonus and the Babinski sign were absent. The pupils responded normally to light; there were no sensory changes or definite atrophy and no paralyses or sphincter involvement. The speech was hesitant, explosive, difficult to understand, and there were momentary periods when he could not speak at all. The patient had no gross mental defect. He was illiterate, but his memory was good. He was able to make his family understand him and was acutely aware of all that was going on about him. The blood Wassermann reaction was negative.

Much interest attaches to the part of the brain implicated in this defect. The disorder has been styled dystonia lenticularis. It has been placed in the group of corpus striatum diseases. Dr. J. Ramsey Hunt, writing recently, reconstructs the corpus striatum on histologic and functional lines, by dividing it into neostriatum (caudate nucleus and putamen) and paleostriatum (globus pallidus). To the former he assigns a coordinating and an inhibitory influence on the motor functions of the corpus striatum. Involvement here, leads to choreiform or spontaneous movements of the automatic associated type. Hunt regards dystonia musculorum deformans as related to the neostriatum.

DISCUSSION

Dr. N. W. Winkelman: Two or three things are suggested in this discussion. In studying the basal ganglions pathologically one is struck by the similarity of the caudate and putamen. Both are identical histologically, and they are developed at the same time and from the same structure. The globus pallidus is developed at a totally different time and has a totally different structure. The lenticular and the caudate nucleus have the same type of cell, a motor type such as is found in the cerebral cortex in the motor area and in the anterior horn cells. In certain conditions, especially in paralysis agitans, there is a disappearance of the large motor cells from the basal ganglion not limited to the globus pallidus, while in Huntington's chorea the pathologic condition is found in the smaller type of cells. There is no sharp anatomic delimitation of these two types of cells, for while the corpus striatum is composed mainly of the smaller type of cell it still contains some of the larger motor type of cells.

Dr. William G. Spiller: There is a striking relation between some of these disorders of the lenticular nucleus. It is interesting but not contradictory that certain members of a family have this disorder, because I believe there is a close connection between dystonia lenticularis manifestations. I have been in doubt whether the functions of the different parts of the lenticular nucleus can be definitely separated from one another; whether there can be destruction of the globus pallidus without organic or at least functional disturbance of the putamen.

In the case of double athetosis with bilateral destruction of the putamen, which I reported in the Archives of Neurology and Psychiatry, volume 4, October, 1920, the destruction of the putamen was as nearly isolated as one can expect, and yet the globus pallidus was not normal.

Dr. Charles K. Mills: I have always been interested in this class of cases, particularly because I have expounded before this Society more than once my belief in a separate extrapyramidal system, which I sometimes call the tonectic cerebral apparatus.

Dr. F. X. Dercum: I agree in general with Dr. Mills as to the interpretation of cases of this kind. Possibly there are two factors to be considered. Dr. Yawger's case was that of a patient born at eight months, and in all probability with a failure of normal cortical motor development; the axons of the cortical motor neurons had probably never fully completed their course to the cord. The normal tonicity of the muscles is due to the interplay of the motor cortex and of the subcortical motor centers, especially the globus pallidus. If one or the other, that is, either the pyramidal or the pallidal system be diseased, disturbances of muscle tonus must make their appearance. The normal balance between motor impulses descending from the pyramidal tract and those descending from the pallidal system are no longer counter-balanced and are no longer mutually inhibited, and one being destroyed or imperfectly developed, we have an overflow over the other. It is the pyramidal overflow which gives rise to the spasticity and rigidity in paralysis agitans; it is the pallidal overflow which gives rise to the rgidity in hemiplegia. In the present case the deficiency of development of the motor area of the cortex throws the balance over the subcortical motor centers, the corpus striatum. Hunt believes that the disorders of association should be referred to the caudate nucleus, a position which, together with others, I am strongly inclined to accept. In the present instance the symptoms are obviously to be referred to both caudate nucleus and the putamen on the one hand and the pallidum on the other. We should bear in mind, also, the facts of morphology. In reptiles and birds the striatum is the cerebral motor organ. In mammals, it is superseded and its function usurped and inhibited by the pallium, the cortex, which appears so much later in the course of evolution. We can perhaps understand, when the motor area of the cortex fails of full development, that the striatum should be left to act unrestrained and uninhibited; or on the other hand, the striatum having failed of development or undergone disease, we can understand that there should be both spasticity and absence of association of movements. Probably the present instance is complicated by the fact that both the motor area of the cortex and the striatum are each in some degree impaired; probably the striatum has suffered most.

Dr. Charles S. Potts: The case shown does not seem to present the typical symptoms of dystonia musculorum. There is not present the violent spasm of the muscles about the pelvis, the torsion movement, which has given one of the names, tortipelvis, sometimes applied to this condition. Lordosis is absent, and in the other members of the family afflicted with the disease there had been marked mental deterioration which is not a symptom of dystonia. It seems to me that as dystonia musculorum and Huntington's chorea are both believed to be due to disease of the lenticular region, a good deal of this question might be distinction without a difference.

Dr. Charles M. Byrnes: I am quite certain that Dr. Ramsey Hunt has made a distinction between symptoms due to a lesion in the globus pallidus and those associated with a lesion in the putamen. I agree with the opinion expressed by Dr. Spiller that such a distinction is, perhaps, not clinically possible.

In connection with the extrapyramidal system, I wish to relate an observation suggested by the study of Sinkler's toe reflex presented to this Society by Dr. Spiller. I repeated the experiment on a case of spastic paraplegia in which it was observed that the Babinski toe reflex, the ankle clonus and the spasticity were abolished for a period of five minutes after the release of the flexed toes. The same experiment was tried on a case of old hemiplegia in which, however, flexion of the toes failed to relieve the spasticity or alter the reflexes. I believe that in the latter instance, failure of the reflex action might be due to preservation of extrapyramidal function.

A CASE OF EPIDEMIC ENCEPHALITIS PRESENTING UNUSUAL SEQUELAE. Presented by Dr. George E. Price.

In January. 1920, a boy, aged 11, became ill with epidemic encephalitis. presenting fever, diplopia, somnolence, etc., and had apparently recovered when in the following July he developed attacks of dyspnea. He complained of headache and dizziness; breathing would be suspended for a brief interval, when he would become cyanotic; then would follow a period of rapid breathing. One such attack, timed by Dr. Sellars, lasted for two and one-half minutes. The child would have no recollection after the attack as to what had occurred. While remaining about the same in frequency, an average of four or five attacks in twenty-four hours, the spells gradually changed somewhat in character, losing the earlier period of suspended respiration and cyanosis.

When examined in September he was having paroxysms of very rapid, difficult breathing and markedly accelerated heart action, accompanied after from thirty to sixty seconds by an intense frontal headache. The child retained consciousness throughout the attack to such an extent that he would respond correctly when spoken to, yet after the spell was over he would have no recollection of what he had said. It was noted that the paroxysms occurred most commonly in the morning, shortly after waking. A careful neurologic examination was negative; the heart and lungs were normal and the urine was negative.

The child's history previous to the attack of encephalitis was uneventful from a medical standpoint, and the family history had no bearing on the case.

The only plausible explanation for this syndrome would seem to be that there is an intermittent disturbance of the centers in the medulla, of vascular origin, occurring as a sequel of the encephalitis. These so-called "bulbar crises," while rare, have been observed by other writers.

THE SYNDROME OF THE LONG FIBERS OF THE CROSSED PYRAMIDAL TRACT (SUBACUTE DEGENERATION). Presented by Dr. Alfred Gordon.

After a historical review of the subject of subacute degeneration of the white columns in the spinal cord, the speaker called attention to cases of posterolateral sclerosis without anemia. A differential diagnosis between the classic combined sclerosis and that occurring from subacute degeneration of the posterior and lateral columns of the cord was emphasized. Dr. Gordon then discussed the pure type of lateral sclerosis, of which he found only six cases in the literature. He took up the main subject of his observations, namely, the possible occurrence of a subacute degeneration confined exclusively to the pyramidal tract in the cord. He had under his observation for several years two patients whose clinical picture was not at all that of primary lateral sclerosis, but nevertheless there were striking evidences of involvement of the motor tract in the cord. At no time was there a rigidity of the affected limbs, but the patellar tendon reflexes were markedly exaggerated, the plantar reflexes were extensor in type, and ankle clonus was present. There were no sensory disturbances and no sphincter involvement. Spasmodic involuntary contractions of the muscles of the affected limbs were present throughout the illness. Dr. Gordon believed that besides the classical posterior and posterolateral sclerosis there exists a subacute involvement of the posterior, of the posterolateral and finally of the sole lateral (motor) tracts.

CHARCOT JOINTS OF THE SPINAL VERTEBRAE. Presented by Dr. F. X. Dercum.

Dr. Dercum exhibited the roentgenograms of two cases of Charcot spine. In both instances the patients suffered from undoubted and typical tabes; in one of them there was in addition a large arthropathy of the right knee; also exhibited in a roentgenogram.

Dr. Dercum said that he wished to emphasize the differential diagnosis between Charcot spine and tuberculous spines. He especially dwelt on the significance of the absence of fixation, the absence of muscular spasm, of mobility, and especially the absence of pain. The roentgenograms of Charcot and tuberculous spines may superficially resemble each other. He thought they should not be interpreted from roentgenograms alone, but from the clinical signs as well. By themselves the reontgenograms may unquestionably lead to error.

Book Reviews

KORPERBAU UND CHARAKTER (PHYSICAL DEVELOPMENT AND CHARACTER). By DR. ERNST KRETSCHMER. Berlin: Julius Springer, 1921.

Dr. Kretschmer's researches contain a great many interesting and valuable suggestions, even though one may not be willing to accept all his conclusions. Briefly: He has discovered a more or less persistent line of parallel development between the physical characteristics of his mentally diseased patients and the types of mental disturbance which they present. It is not the old idea of the body influencing the general trend of the mind or of the mind stamping the body with certain definite stigmas. Stated in such a way the thesis of his book might seem vague and subjective, while, as a matter of fact, his method of procedure is intensely objective and accurate. The time was when we thought of human beings as divided into two compartments, "mind" and "body," and considered each compartment separately. "Mind" was enclosed in one airtight compartment of the personality, while side by side with it was another compartment which we termed "the body and its functions." These two compartments were so clearly outlined that although they might have points or even surfaces of contact, there was no interaction between them. The psychiatrist when attempting to describe the influence of the mind on the body was forced to overcome a distrust lurking in the background of most people's thought—a well grounded unwillingness to believe in the existence of some mysterious mental power which might enable "the mind," in its compartment, to destroy the wall between it and "the body," and so to reach the physical functions by means of a break in its own continuity. Such a break suggested, at the least, an abnormal condition either of the body or the mind, or of both. Fortunately, this old idea of the two noncommunicating compartments, although it still persists in the mind of the laity—to a degree often unappreciated—has ceased to dominate medical thought and practice. In its place we have won our way to the conception of integration, to the functional unity of the personality, in which there is no dividing line between the physical and the mental. Viewed from this standpoint, Dr. Kretschmer's ideas are possible and acceptable.

He began his work by making very complete and detailed physical measurements and descriptions of the bodies of his patients. From a classification of these measurements several types of physical outline naturally emerge and become more or less clearly defined. Kretschmer distinguishes three principal types: (1) an asthenic type, (2) an athletic type, and (3) a pyknic type (from the Greek πυκνός = fat). There are a few other less numerous groups which do not fit exactly into any of these three major classes and which are composed of mixed types, which the author calls "dysplastic," "polyglandular," "infantile," or "hypoplastic." These last, however, are borderline cases which appear to Kretschmer to show symptoms of a disturbed endocrine balance.

Having thus first classified the physical characteristics of his patients, he has discovered that the athletic and the asthenic types are always associated with schizophrenic disturbances, while the pyknic type suffers from manic-depressive psychoses or, as he prefers to call it, from a "cycloid diathesis." His conclusions lead him also to a tentative theory of temperament. He finds that his "asthenic" and "athletic" physical types exhibit those mental reactions which reach their extreme pathologic expression in cases of schizophrenia, while a pyknic physical habitus is always associated with a temperament that varies between the pathologic extremes of excitement and depression. The practical value of such a fact is self-evident. There are, for instance, certain evident hallmarks of the athletic and the asthenic type (for example, the comparative measurements between the circumference of the shoulders and that of the pelvis, or types of hair formation), which enable the psychiatrist to classify a patient who shows these characteristics as being likely to develop a schizophrenic psychosis rather than a manic-depressive one. This, is especially valuable in cases in which the psychosis is in its incipiency and in which it is possible to confuse a beginning schizophrenia with a mild depression. The reviewer has taken the trouble to test a number of Dr. Kretschmer's physical "sign posts" and in the brief period during this experiment has been greatly helped in the prognosis of puzzling cases.

It may be interesting to give a brief outline of the different physical types and their more important characteristics, which Kretschmer has outlined.

1. The asthenic schizophrenic type is distinguished especially by the small skull, the profile with its comparatively long nose, and the face by an outline resembling a shortened egg; more especially still by the acute angle of the profile, one side of which runs from the receding forehead downward with its apex at the point of the prominent nose and with its other side running from the apex of the nose downward and inward to the point of the receding chin. The body hair of this type is also characteristic. There is an excessive development of primary hair. The hair of the head is not only very thick, but it extends beyond the normal borderlines. It grows low over the occiput, and especially on the forehead and temples so that the usual bare spot at the temples is covered with fine hair; and there is a more or less definite bridge of primary hair between the terminal hair of the temples and the temporal ends of the eyebrows. The eyebrows themselves are very broad and thick and flow together over the base of the nose.

2. The athletic schizophrenic face has an outline that is egg-shaped, but that is lengthened instead of being shortened. The bony skull is larger, also more massive and higher. Especially characteristic are the broad outstanding shoulders, the deep chest, the firm receding abdomen which grows slighter as it descends so that the pelvis and the legs appear almost adolescent in type in comparison with the heavy arms and the hypertrophic shoulders.

3. The pyknic-cyclothymic type has also a very distinctive facial outline. It is flat and distinctly five cornered; the two temples, the two apexes of the angles of the lower jaw and the point of the chin forming the sides of the pentagram. The body is characterized by the excessive development of the thorax and abdomen in comparison with the rest of the body. The tendency to fleshiness is confined to the body, the extremities being much slighter and much less heavy. It is difficult to describe in a few words the characteristic differences of these types, which, however, spring to the eye at once when one analyzes the excellent photographs that are included in Kretschmer's book and which, unlike the photographs in many psychiatric monographs, form with the surrounding text an inherent unity of interest. There is not a photograph in the book that is unnecessary or mere padding.

Kretschmer, however, is not satisfied simply with presenting the facts of his thesis. He has a most fascinating chapter on "Die Genialen" (types of men of genius), in which he discusses the cyclothymic type of artistic temperament, as well as the schizothymic type among artists, authors, scientists, philosophers and diplomats. The amount of general knowledge and reading that lies back of this single chapter is in itself enormous.

Kretschmer's book ends with a brief chapter on his "Theory of the Temperaments," which is in itself so suggestive, so full of new points of view that it deserves to be read carefully by every one who is interested not only in those stray types which drift as patients into his office, or his clinic, but who has a broader desire to understand the varying human elements with which his daily life brings him in contact; and even to get a still deeper insight into the reactions of those groups of persons who make up the composite pictures of different peoples and nations.

He constantly draws the line between what science knows and what he himself seeks to prove on the basis of such knowledge, between his scientific data and his personal conclusions. It is quite possible that the reader may not entirely agree with much that he has written. There are, of course, many gaps in his evidence which later research may be able to fill. On the whole, however, a book such as this, which bears on every page the stamp of patient investigation, is not only a definite contribution to our understanding of human personality, but is also an inspiration to thought and to further investigation on the part of every one who will read it carefully from beginning to end.

ACUTE EPIDEMIC ENCEPHALITIS (LETHARGIC ENCEPHALITIS). An Investigation by the Association for Research in Nervous and Mental Disease. Report of the Papers and Discussions at the Meeting of the Association, New York City, Dec. 28 and 29, 1920. Prepared under the direction of Walter Timme, M.D.; Pearce Bailey, M.D.; Lewellys F. Barker, M.D.; Sanger Brown, 2d, M.D.; Charles L. Dana, M.D.; J. Ramsey Hunt, M.D.; Foster Kennedy, M.D.; T. H. Weisenburg, M.D.; George H. Kirby, M.D.; Hugh T. Patrick, M.D.; Bernard Sachs, M.D.; William G. Spiller, M.D.; Israel Strauss, M.D.; E. W. Taylor, M.D., and Frederick Tilney, M.D. Price, $2.50. Pp. 258. New York: Paul B. Hoeber, 1921.

In December, 1920, the Association for Research in Nervous and Mental Diseases held its first meeting; two days were devoted to the study of lethargic encephalitis. There were thirty-five contributors, to each one of whom some branch or phase of the subject had been assigned by the Commission of the Association because of his known attainments. There was no general discussion of the papers presented, but the contributor was expected to defend his thesis, if necessary, and to answer all questions.

The total output of the conference was taken in hand by the Commission, sifted and arranged; duplications were eliminated and superfluous matter deleted. What was left was put into book form by the Publication Committee. The material is arranged in seven chapters and covers the subject from history, incidence and etiology through symptomatology (three chapters), diagnosis, prognosis, morbid anatomy and bacteriology to animal experimentation and immunology. The book certainly is the best thing on this subject that has appeared.

The Publication Committee very wisely has included "all questions of clinical bearing submitted by the Committee and answered by the contributors." Doubtless many of these questions would have occurred to the reader. He finds them answered.

Another feature of great value is the "conclusions of the Commission" which terminate each chapter. The Commission, in short, sits as a jury on the communications and delivers its verdict. As the members of the Commission are nearly all known leaders of neurology in this country, their verdict may be considered about as final as any verdict can be in the present flux of medical knowledge. A remarkably full bibliography, eighteen pages, closes the volume.

That the profession and the public owe a great debt to every one concerned in the production of this volume will quickly be apparent to any reader.

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MULTIPLE CEREBRAL TUBERCLES

A CLINICAL AND ANATOMOPATHOLOGIC CONTRIBUTION *

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If at times the difficulties of diagnosticating a cerebral tumor are great, especially in those cases in which one wishes to obtain a precise localization, they become almost unsurmountable when one attempts to establish the presence of multiple cerebral tumors. Having had the opportunity to study two cases of multiple cerebral tumors in the Royal Neurological Clinic of Rome, and of performing necropsies on both of them, it seemed opportune to publish a report of these cases, hoping thereby to be able to contribute, even in a small way, to the study of so difficult a question. I shall first outline the clinical histories of the two cases coming under my own personal observation.

REPORT OF CASES

Case 1.—*History.*—Ottavi Giovanni, aged 28, a farmer, drank wine moderately, did not smoke and denied syphilis. He had left lobar pneumonia in 1914; in 1918, following a thoracic wound received in the war, he had a left-sided pleurisy, but he stated that he had fully recovered from both conditions. He remained in good health until the end of October, 1919, when he began to complain from time to time of a moderate pain in the back of the neck which spread two weeks later to the occiput and became continuous with exacerbations influenced by nocturnal hours and atmospheric changes. During the early part of December, 1919, he began to notice weakness of the extremities, especially of the lower ones; he could not easily remain in an erect position and, when walking, he had a tendency to fall, first on one side then on the other. During the following two weeks the headache acquired the characteristics of true violent crises of short duration, often accompanied by emesis and occurring several times during the day. By the end of December the patient complained of diplopia, especially after an attack of headache, with bilateral diminution of vision. During the last few days preceding his admission to the clinic, he also noticed paracusia in the right ear and slight diminution of hearing of the left ear. He entered the clinic on Dec. 30, 1919.

Objective Examination.—This revealed a man of medium height, normal build and in a good general state of nutrition. Objective examination of the internal organs was negative. Urinalysis was negative as regards albumin and sugar.

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* From the Neurologic Department of the Royal University of Rome, Professor G. Mingazzini, Director.

Neurologic Examination.—While at rest, a slight tendency toward internal deviation of the left eye was noted. Monocular examination for oculomotor movements revealed a moderate limitation of external deviation of the left eye; the same limitation, but to a lesser degree, existed in the right eye. At the same time, nystagmic twitchings were revealed, especially right-laterally. Binocular examination showed that upward movements of both eyes were incomplete and that the left eye, in its upward movements, tended to develop a concomitant internal squint. Downward rotation also appeared to be slightly limited in the left eye. All other eye movements were normal though accompanied by slight though demonstrable nystagmic twitchings. Frowning was bilaterally normal, but closure of the eyelids was more forceful on the right side. While showing his teeth, it was noticed that the patient's left perioral muscles were slightly weaker than those on the right side. Protrusion of the tongue was complete, without deviation, and all of its movements were normal. The left side of the uvula was slightly lower than the right and contracted less fully in phonation. Mastication, deglutition and speech were normal. There were no faulty attitudes of the head. Active and passive movements of the neck were all obtainable, but, beyond a certain range, especially in flexion and lateral extension, these movements gave rise to intense occipital pains. Likewise the upper extremities showed neither abnormal attitudes nor trophic muscular changes. Only on passive movements the various segments of both upper extremities revealed a slight resistance; active movements were all present and complete. When elevating both hands, as in the act of taking oath, more or less accentuated tremors were noted, with occasional isolated finger movements and a slight tendency for the left hand to drop down sooner than the right one. The dynamometer showed: right hand, 19; left hand, 16. The lower extremities, especially the left one, showed an evident tendency toward external rotation. As in the upper extremities, resistance to passive movements was above normal; active movements were all present and complete. When the patient lifted his legs from the bed, the left one was lowered before the right; both limbs oscillated more or less in various directions. When the patient tried to raise himself from a recumbent to a sitting posture, with arms folded across the chest, both heels were simultaneously lifted off the bed (asynergy); the left foot was at times lifted to a higher level than the right one. The patient was able to assume the erect position by spreading his feet, but the body oscillated, especially when the eyes were closed. When walking, the feet were always spread apart; from time to time the patient would start to fall toward the left. Backward flexion of the spinal column was accompanied by flexion of the knees. The patellar and tendo-achilles reflexes were prompt, more so on the left than on the right. The plantar reflexes were usually absent, occasionally normal. The adductor reflexes of the right side were more promptly obtained than on the left; the abdominal reflexes were normal, the epigastric reflexes absent; the tendon reflexes of the upper extremities were slightly more active on the right than on the left side. Both masseter and mandibular reflexes were absent. The conjunctival and corneal reflexes were normal. The various forms of superficial and deep sensation were everywhere well preserved. There were no dynamic ataxic disturbances in either the upper or lower extremities. Percussion over the left side of the occiput and pressure over the paracervical region and supra-orbital and infra-orbital nerves, especially on the left side, all gave rise to slight pain. Vision was 1/6 without any correction. Color perception was present but bilaterally labored. Both fields of vision were also somewhat restricted. Fundi: On the left side there was slight swelling of the papilla; the edges of the disk were slightly indistinct and somewhat pale in its temporal half. The papillary vessels were congested. Taste and smell were normal.

Examination of the Ears.—Whispering was heard at a distance of 3 meters on the right side and at 1 meter on the left side. The ticking of a watch was heard at a distance of 30 cm. on the right side, and at a distance of 10 cm. on the left side. Acoustic Tests: The Rinne test was inverted on the left side and normal on the right. The Weber test revealed right lateralization with ears open or closed.

Labyrinth Examination: There was (*a*) thermal nystagmus on applying the cold test (15 C.). When the right auditory canal was irrigated and the patient was asked to look in the opposite direction, that is, toward the left, no nystagmic movements were elicited, whereas the latter became evident when the patient was asked to look in the same direction, that is, toward the right. When the left canal was irrigated for two minutes and the patient was asked to look in the opposite direction, demonstrable nystagmic movements were elicited which became barely perceptible when the eyes were turned to the left. Thermal test was made at 40 C. On irrigating either ear for about two minutes, nystagmic movements appeared when the patient was asked to look in the opposite direction, that is, away from the irrigation, whereas no nystagmus appeared when he looked in the same direction as the irrigation. (*b*) Voltaic Dizziness: On applying a gradually increasing galvanic current to the bitemporal region a constant inclination of the head to the left was obtained, regardless of the position of the poles of the current. (*c*) Rotation Test: After twirling the patient around ten times in twenty seconds in a Bárány chair from right to left, no nystagmic movements were elicited when he looked toward the right, but they became evident if he looked toward the left. After twirling him around from left to right and then asking him to look toward the left, there were no nystagmic movements, but the latter appeared if he looked to the right. (*d*) Bárány's Index Test: When, with closed eyes, the patient was made to carry the tip of his left index finger from below upward in order to reach a previously indicated point, the finger constantly deviated externally. The right index rarely, and to a slight extent, also tended to deviate externally.

Psychic Examination.—Attention was fair; perception was correct; orientation as regards place, time and person was normal; memory was sufficiently normal both for past and present events; he had subnormal calculating ability; he showed scarce *critique;* weak association; no disturbance of ideation and of the psychosensory sphere, and diminution of the affective tone. The patient evinced little interest in his case and made no inquiries regarding the nature of his malady or of the possibility of its being cured.

Course of Disease.—Lumbar puncture resulted in a few drops of limpid, transparent fluid, too small a quantity for the carrying out of any tests. The blood Wassermann reaction was negative. Roentgenograms of the cranium were not obtained.

During his hospitalization in the clinic the patient had repeated violent seizures of occipital headache, sudden in onset, accompanied in the early part of the attacks by reddening of the face and tachycardia of from 120 to 130, terminating in bradycardia of 45 to 50. He died in January, 1920, during one of these seizures.

Postmortem Examination.—The cranial bones were negative. The cerebral convolutions appeared to be slightly collapsed; the meninges were normal. On the right side of the posterior cranial fossa, in the cerebellum, was a small tumor the size of a hazelnut, of roundish form and firm consistency, firmly adherent to the underlying meninges (Fig. 1). On the inferior aspect of the right cerebellum and precisely on the lateral half of the lobus biventralis was a small depression in which was lodged the tumor without adhering to it. The right cerebellar tonsil, enlarged, deformed and of increased consistency, was pressing against the inferior lateral surface of the medulla (bulb), causing the latter to deviate toward the left side (Fig. 2). In the area in which the left side of the pons is continuous with the middle cerebellar peduncle, a roundish tumefaction was found, grayish, and hard to the touch; the cerebellar peduncle itself was atrophied and flattened out dorsoventrally (Fig. 2).

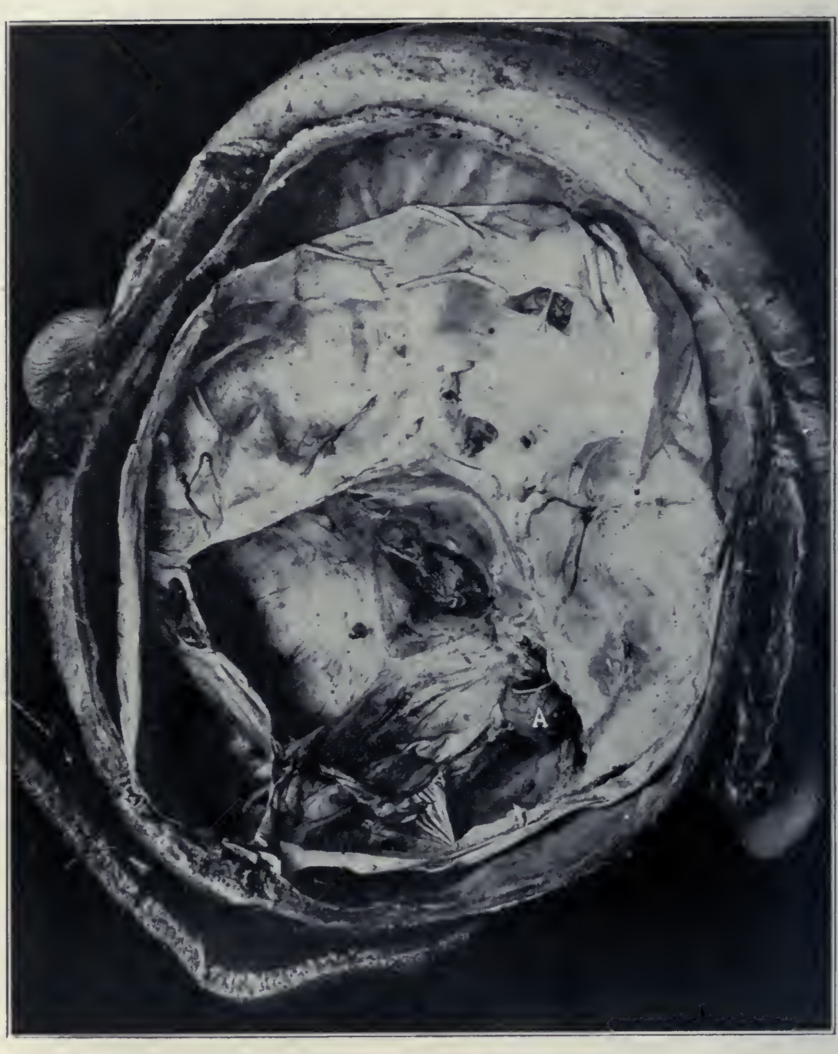

Fig. 1 (Case 1).—Tubercle of the right cerebellar fossa.

The roots of the left fifth nerve were manifestly thinned out, flattened and dissociated. The rest of the brain and the other cranial nerves showed no appreciable alterations. On cutting anteroposteriorly over the right cerebellar tonsil, the surface of a small grayish tumor the size of a hazelnut came into view; it could be readily enucleated from its bed. No other abnormalities could be detected in making sections of the cerebellar hemispheres, bulb or right half of the pons. On the other hand, a transverse section through the left half of the pons brought to view a third tumor of the same shape, size, color and consistency, which could also be readily enucleated. The depression in which it lay was partly formed at the expense of the lateral portion of the pons, but more largely in the corresponding half of the middle cerebellar peduncle which was not only flattened and distorted but also thinned out.

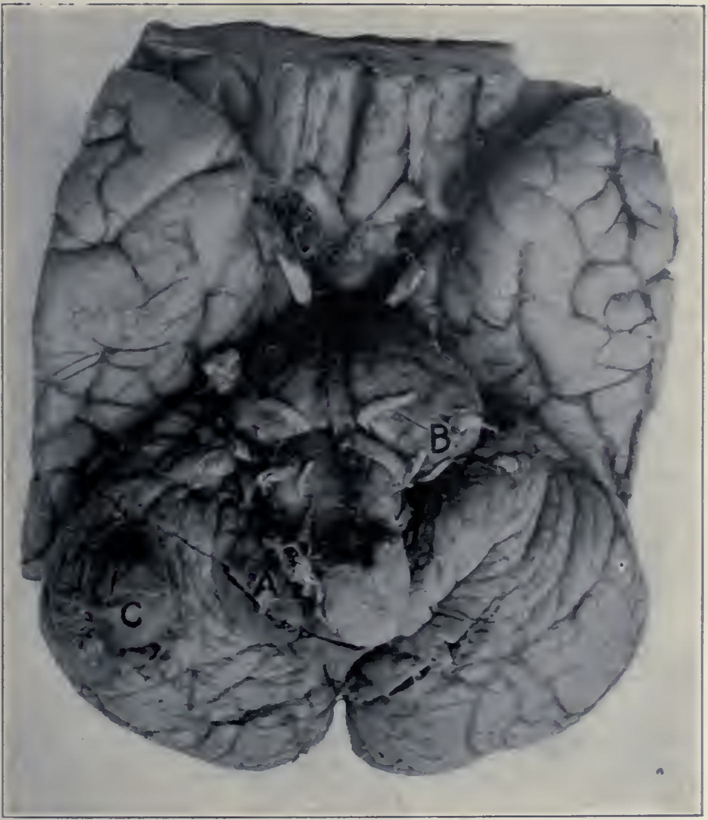

Fig. 2.—Multiple cerebral tubercles occupying: (*a*) the right cerebellar amygdala; (*b*) the left middle cerebellar peduncle and extending into the adjacent portion of the pons; (*c*) depression in which was lodged the tumor of the right cerebellar fossa in Case 1.

Anatomopathologic Diagnosis.—Multiple cerebellar tumors of the right posterior fossa. right cerebellar tonsil and left median cerebellar peduncle extending to the contiguous part of the pons were diagnosed. Histologic examination (hematoxylin-eosin stain) confirmed the diagnosis of tubercle.

SUMMARY AND CONCLUSIONS

The case was that of a 28-year old man who, October, 1919, began to complain of moderate headache, at first located in the neck, later occipital in nature. By December of the same year he had difficulty in maintaining the erect position and in walking in a given direction. A few weeks after the onset of headache the headaches became true crises of short duration, fair intensity, usually diurnal and sometimes associated with vomiting; at the same time vision began to diminish and diplopia appeared. A few days before being admitted to the clinic the patient noticed paracusia of the right ear and slight hypo-acusia of the left ear. The neurologic examination revealed bilateral paresis of the sixth cranial nerves, especially on the left side; slight paresis of the left seventh nerve; slight hypertonia of the upper and lower extremities; slight asthenia of the left extremities; bilateral "flexion combinée," more marked on the left side; accentuated Romberg sign; a tendency for the body to fall toward the left when walking; patellar and tendo-achillis reflexes more prompt on the left than on the right side; adductor and tendon reflexes of the upper extremities more pronounced on the right then on the left side; slight tenderness over the left occiput over the paracervical depressions and over the first and second branches of the fifth nerves, especially on the left side; slight static ataxia of both upper and lower extremities, bilateral diminution of the visual field; slight papillary stasis of the left side; slight bilateral weakness of the fifth nerves; left hypo-acusia; signs of vestibular nerve lesion, especially on the left side; positive "index finger test" on the left side; slight intellectual torpor.

As already stated, necropsy revealed the presence of three tubercles, two on the right side in the posterior fossa and cerebellar tonsil, the third one in the middle cerebellar peduncle with extension into the pons.

The clinical diagnosis had been that of left cerebellar tumor; the presence of two right-sided tubercles was not suspected and the tumor on the left side was found in the brachium pontis and contiguous portions of the pons itself rather than in the cerebellar hemisphere. It was easy to presume that one was dealing with a cerebellar neoplasm, in view of the progressive nature and symptomatology of the morbid process. Regarding the site of the tumor, the Rolandic area was easily excluded on account of the absence of jacksonian convulsions and dissociate paralyses; the occipital lobe likewise, owing to absence of homonymous lateral hemianopsia; the parietal lobe because there were no sensory alterations; the frontal lobe could not have been involved because the psychic disturbances were so slight in degree and tardy in appearing; the basal ganglions (thalamus) were excluded because alterations of sensibility, phenomena of motor irritability and mimic emotional disturbances were all absent. The hypothesis of a tumor of the bigeminal eminence could not be entertained because it was impossible to demonstrate dissociate and asymmetrical ophthalmoplegia which should have been present from the onset of the malady, constituting the clinical syndrome in this region. Neither could the possibility of a tumor of the cerebral pedicle be considered on account of the absence of even a trace of alternating paralysis of the Weber type; still less could a bulbar tumor be suggested, there being no disturbance of the last pairs of cranial nerves, no isolated or crossed paresis of the extremities, no characteristic alternating syndrome (Avellis, Goukowski-Giannuli) which are found in tumors of this region.

There only remained the hypothesis of a tumor of the temporal lobe, of the pons or of the cerebellum. Suggestive of temporal lobe tumor were the bilateral paresis of the sixth nerves, slight left hemiparesis, paracusia and hypo-acusia, together with the cerebellar phenomena; against this diagnosis were: absence of palpebral ptosis, of mimic paralysis, of alterations of stereognostic sense, of aphasico-sensorial or dysarthric disturbances if the tumor had been situated on the left side (first group of Mingazzini); absence of conjugate deviation of the head and eyes, of paralysis of the third nerves and of contralateral hemiparesis (second group of Mingazzini); absence of palpebral ptosis, of isolated paralysis of the seventh nerve and of hemianesthesia (third group of Mingazzini); total absence of olfactory and gustatory disturbances (fourth group of Mingazzini).

On the other hand, the possibility of a pontile localization of the tumor was much more likely. As is well known, the typical syndrome of a pontile tumor includes an inferior alternating hemiplegia, including paralysis of the facial, abducens and of the trigeminus of one side (or of one of the three nerves), with concomitant paralysis of the opposite extremities. Sometimes the cranial nerves may be affected bilaterally and the hemiplegia may be a double one. In this particular case there was exactly a tetraspasm with left hemiasthenia, a bilateral paresis of the abducens, more evident on the left side, and a bilateral lesion of the eighth nerve, all phenomena favoring a pontile localization of the tumor. Nevertheless, the disturbances of station and of gait. which could not be accounted for on the assumption of either spasm or paresis, the cerebellar asynergy and the positive index finger test of the left side spoke against a pontile tumor, especially as the latter symptoms had appeared at the very onset and dominated the clinical picture. For these reasons it seemed more logical to adhere to the hypothesis of a cerebellar tumor, especially as the disturbances of the erect position and of walking, the asynergy of the lower extremities and the index finger test, as well as the headache of occipital type, the occipital and superior paracervical pains all favored this conclusion. The late-appearing bilateral paresis of the abducens did not speak against this same hypothesis, in view of the slight resistance of this nerve to any kind of cerebral hypertension; neither did the signs of eighth nerve lesion, especially of its vestibular portion, in view of the anatomic and functional connections between the nuclei of the vestibular nerve itself and of the cerebellar gray matter. Furthermore, the tendency to fall to the left, the greater degree of percussion pain over the left side of the occiput, the greater degree of left abducens paresis, positive index finger test, accentuated on the left side, all made one suspect that the tumor must be situated in the left cerebellar hemisphere and that it also compressed the corresponding median cerebellar peduncle. The tetraspasm and slight left hemiparesis were not sufficiently important signs to throw out this hypothesis because, although it is true that some patients show atony and asthenia of the corresponding extremities, it is also a fact that in some cases one may find hypertonia when the tumor causes oblique contralateral symptoms (Murri), because the opposite half of the pons is compressed against the occipital bone. The negative anamnesis, normal general condition of the patient and absence of focal tuberculosis in the other organs, excluded the possibility of a tubercle and favored the existence of a neoplasm of malignant nature.

Yet the necropsy findings were entirely different, consisting, as already stated, in multiple cerebellar tubercles situated in the right cerebellar hemisphere, right posterior cranial fossa and left median cerebellar peduncle, the latter extending into the adjacent portion of the pons.

Let us now see whether, after confronting the clinical history with the necropsy report, it might have been possible to have arrived at a more complete diagnosis intra vitam. The absence of any portion of the bulboprotuberantial syndrome which characterizes neoplasms of the posterior cranial fossa made it impossible to suspect the existence of a tumor in this region. The absence of symptoms in this case in all probability depended on the special location of the tubercle on the lateral half of the cerebellar fossa and its small size which prevented it from causing any pressure upon the pons, bulb or its adjacent cranial nerves. It is strange that all signs pointing to a cerebellar localization should have been absent in spite of the close relationship of the tubercle and the lobus biventer of the right cerebellar hemisphere between which it had formed a true depression, and the existence of a second tubercle in the cerebellar tonsil of the same hemisphere. If one admits the possibility that the medullary zones of the lobulus biventer and of the tonsil are functionally silent, a plausible explanation for this absence of symptoms is found. As for the symptomatology which we attributed to the supposed tumor of the left cerebellar hemisphere, which, on the contrary proved to be normal, it is evident that it could only depend on the presence of the tubercle situated in the median cerebellar pedicle and adjacent portion of the pons. As a matter of fact, the slight tetraspasm, bilateral paresis of the abducens, especially marked on the left side, and bilateral lesion of the eighth nerves, all of which we believed to be due to an oblique contralateral action of the supposed tumor of the left cerebellar hemisphere against the occipital bone of the opposite side, were merely the result of the pontile location of the tubercle. If, therefore, it was impossible to make an intra vitam diagnosis of the tubercles in the right cerebellar fossa and cerebellar tonsil, one might have suspected the presence of the pontile tumor; the constant tendency for the patient to fall toward the left when walking can probably be fairly explained on the basis of invasion of the corresponding median cerebellar peduncle. One may therefore deduce that the error in not diagnosticating the multiplicity of neoplasms was almost inevitable, as was also the nature of the neoplasms in view of the total absence of a history and of clinical findings pointing to a tuberculous lesion.

Case 2.—*History.*—Giotti Angelo, aged 14 years, had never had any serious illnesses. The father was neither alcoholic nor syphilitic; the mother had given birth to eight sons, of whom three died in infancy of acute infectiousness; she had had no miscarriages. Toward the end of 1913 the patient began to complain of rather intense headache coming on especially in the afternoon, continuous from the onset and localized at the bregma, later intermittent and localized in the occiput. At its acme the headache was often accompanied by vomiting and sometimes by diplopia. The mother stated that during the previous two months the boy had become pale and complained of fatigue and prostration; she did not know whether he had ever been feverish.

Objective Examination.—Dec. 30, 1913: Examination revealed a normal skeletal structure, a limited amount of panniculus adiposus, global muscular atrophy and the skin and mucous membranes markedly pallid. There was left apical sclerosis. The heart was normal, and there were no abnormalities of the abdominal organs. There was no albumin or sugar in the urine.

Neurologic Examination.—Normal oculomotion was revealed on both monocular and binocular examination with the exception of slight nystagmic twitchings in the horizontal direction in extreme lateral movements of the eyes. Normal movements of all muscles were supplied by the seventh and twelfth cranial nerves. There was normal passive and active motility of the various segments of both upper and lower extremities, with the exception of a slight. hardly perceptible, hypertonia, not constant, of the left extremities. The patellar and Achilles reflexes were prompt, as were also the epigastric and abdominal and those of the superior extremity tendons. The pupils were slightly anisochoric (D. > S.); there was normal prompt bilateral reaction to light; the corneal and conjunctival reflexes were normal. The superficial as well as the deep sensibilities, were intact. Cranial percussion did not elicit pain. The sense of smell was well preserved; hearing was slightly decreased on the right side. Vision was diminished on the left side, normal on the right. Lumbar puncture revealed: limpid fluid of increased tension, globulin present, albumin, seven lines of the Nissl's test tube. There were a few lymphocytes in the sediment. The Wassermann reaction was weakly positive.

Status of the Patient on April 12, 1914: The patient still complained of headache of varying intensity, sometimes accompanied by vomiting. From time to time he was seized with vertigo of a subjective type, which was especially likely to come on while changing the position of his body. He also complained of paracusia sometimes of the left and cometimes of the right ear and of bilateral amblyopia. In the quiescent state a slight convergent left strabismus was noticed. Both monocular and binocular examinations for oculomotion revealed a slight insufficiency of the external recti muscles and the onset of nystagmiform twitchings in the horizontal sense, during lateral movements of the eyes. At the same time a homonymous diplopia appeared with images at the same level whenever the patient looked either to the left or to the right. Frowning and palpebral contraction were more forcible on the right side. The right angle of the mouth contracted better than the left when the patient showed his teeth. The tongue was protruded normally, without deviation, and was mobile in all directions, but in the act of protrusion it was nearer to the left angle of the mouth than to the right. The uvula was normal and moved normally during phonation. No dysarthric disturbances were noted. Passive movements of the neck were all slightly resisted with the patient in the dorsal position; this resistance increased as soon as the patient sat up. These same movements, especially those of right flexion, caused severe pains in the neck. Lateral movements of the head to the left were normal, but they were incomplete and forced in all other directions, the right lateral ones especially being painful. All passive and active movements of the upper extremities were obtainable and complete. There was decreased muscular strength in all of the upper-limb segments. Elevation of both hands, as in the act of taking an oath, did not bring out any premature lowering of either hand but only caused a slight oscillation, more marked on the left side. There was no adiadokokinesis.

Passive movements of the lower extremities did not elicit any abnormal degree of resistance. It was impossible to test the active motility of the thighs, the patient complaining of severe pains in the back on making this attempt. For the same reason, the patient could flex but not extend his legs. Movements of the feet and toes were all possible and complete. Muscular strength, especially in the thighs, was subnormal. While lying down, the patient could not raise his lower extremities with the legs in extension; this was more noticeable on the left side. He was able to assume the sitting posture but only with difficulty and by concomitant flexion of the knees; every attempt to obtain passive extension of the legs caused severe pain. With his eyes open, the patient could maintain the erect position with slight oscillations of the body; the latter increasing as soon as he closed his eyes. There was at the same time a tendency for him to fall toward the right, even when walking, though the latter symptom was not constant. The patellar reflexes were active, more so on the right side; the Achilles reflex was present on the right side, almost abolished on the left. Stimulation of the plantar reflex caused flexion of the four little toes and either no response or only slight flexion of the big toes. Oppenheim's sign was absent; abdominal and epigastric reflexes were present and active. The biceps contractions were normal, the triceps weak, the radial and ulnar absent. The Chvostek sign was absent on both sides; the mandibular sign was very weak. The pupils were almost rigid to light and reacted slightly to accommodation; the corneal reflexes were slightly more active on the left than on the right side. Pressure over all of the peripheral nerves caused pain; this was true to a lesser degree of the muscles. The lightest kind of pressure of the neck was extremely painful, especially along the paravertebral depressions. Pressure over the eyes caused pain which was more marked in the left eye.

On palpation of the cranium, a depression, apparently caused by a loss of bone substance was found corresponding to the right cerebellar region; at times a pulsation could be obtained over this depression which was synchronous with the patient's pulse. On applying the stethoscope over this depression a vague bruit was obtained which did not exist over any other part of the occipital bone. Cranial percussion was more painful on the right than on the left side. Objectively, both superficial and deep general sensibility were well preserved. Taste and smell were normal. Bilateral hypo-acusia (watch and Galton whistle) was present; the Rinne reaction was normal; the Weber test was not lateralized.

There was bilateral choked disk, more marked on the right, with hemorrhage of the disk. Vision: right, 1/2; left, 1/6. The basic colors were correctly interpreted, though slowly. The field of vision was shortened in all directions. The pulse rate was 100; respirations, 25.

Psychic Examination.—Attention was weak; perception in general was correct; memory was fairly good both for past and recent events; orientation as to place, time and person was preserved; he was somewhat depressed but only in proportion with his sufferings, otherwise the affective life was normal: neither psychosensorial disturbances nor delusions were present.

Lumbar Puncture.—The spinal fluid was ejected under tension; albumin was present (six lines in Nissl's test-tube); there was no lymphocytosis or reticulae.

Radiographic examination of the cranium revealed a clear space corresponding to the medial portion of the right cerebellar hemisphere.

Conclusions.—The case was that of a 14-year old boy, of rather poor general health who, toward the end of September, 1913, began to suffer from continuous headache of varying intensity, terminating in vomiting. In April. 1914, subjective vertigo appeared with bilateral paracusia. Neurologic examination revealed the following conditions: slight convergent left strabismus; slight bilateral paresis of the sixth nerve and slight paresis of the left seventh nerve; increased resistance to passive movements of the head, with onset of severe pains in the neck; slight hypertonia of the left extremities; slight oscillation of the elevated hands, slightly more accentuated on the left side; the Romberg sign; a tendency for the body to fall toward the right side; greater promptness of the left patellar reflex; almost complete absence of pupillary reaction to light; slight decrease of the corneal reflex on the right; tenderness over the paracervical region; pain on cranial percussion, especially on the right side; bilateral hypo-acusia; choked disk more accentuated on the right side; vision on the right, 1/2, on the left, 1/6; marked hypertension of the spinal fluid with increased albumin content.

In this case also it was easy to suspect a cerebellar neoplasm on account of the decidedly progressive nature and symptomatology of the morbid process. For the reasons given in the preceding case, it was easy to exclude the Rolandic zone, frontal, parietal, temporal, occipital lobe, the basal ganglions, the bigeminal eminences, the cerebral peduncles, the pons and bulb. The only possible clinical localization was that of a cerebellar tumor. The increased resistance to passive movements of the head, Romberg sign, tendency for the body to fall to the right, pain in the neck and on compression of the paracervical regions, and intense papillary stasis, though not constituting a characteristic syndrome, nevertheless, justified a cerebellar localization on account of the impossibility of ascribing these phenomena to a neoplasm situated in any other part of the brain. For the same reasons one was justified in locating the tumor in the right cerebellar hemisphere. The patient's youth, poor general health, left apical sclerosis and slight elevation of temperature also prompted the diagnosis of tubercle.

Treatment and Course.—Operative intervention having been decided on, on June 24, 1914, Professor Alessandri performed a craniotomy of the right occipital fossa over the cerebellar region. On incising and elevating the skin over the pulsating area, the latter proved to be a dilated, sacculated emissary vein of Santorini, the walls of which had produced pressure necrosis of the bony vault. Section of the vessel near the occipital foramen caused profuse hemorrhage, which was controlled by application of wax. On removal of a portion of the right cerebellar bony lamina, the dura appeared under great tension. As soon as the dura had been opened a tumor the size of a small round plum compressing the medial portion of the lobus quadratus was delivered with the fingers. It was partly adherent to the most superficial lamellae of the lobus. On section it proved to be moderately firm and composed of yellow caseous tissue. Microscopic examination confirmed the diagnosis of tubercle. The patient died six days after the operation.

Necropsy Report.—On removal of the brain a large depression with irregular contour was found in the posterior part of the right side of the cerebellum. A horizontal section through the right cerebellar hemisphere revealed the presence of a well outlined tubercle, the size of a small nut, lying on the lateral extremity of the superior and inferior semilunar lobules. A similar section through the right side of the cerebellum revealed two other isolated tubercles also the size of small nuts lying in the cerebellar substance, one in the anteromedian part of the lobus quadratus, the other at the lateral angle of the two semilunar lobules (Fig. 3).

After section of the cerebral peduncles it was noticed that the lamina quadregemina was manifestly deformed, more on the left side. Section of the posterior bigeminal eminence brought to view a small grayish tumor the size of a pea, situated almost entirely in the left posterior bigeminal and partly in the anterior bigeminal of the same side. It crushed and pressed the aqueduct of Sylvius toward the opposite side. There were no appreciable alterations in the pons. Other sections through the brain revealed only a high grade of internal hydrocephalus.

Anatomo-Pathologic Diagnosis.—Multiple cerebral tubercles, one in the posterior bigeminal eminence, and also in part in the anterior, of the left side, two in the right cerebellar hemisphere—medial portion of the lobus quadratus and lateral extremity of the inferior and superior semilunar lobules, and two others in the left cerebellar hemisphere—anteromedial portion of the lobus quadratus and lateral angle of the two semilunar lobules.

Histologic Examination.—Examination with a hematoxylin-eosin stain confirmed the diagnosis of tubercle.

DIFFICULTY OF DIAGNOSIS OF MULTIPLE CEREBELLAR TUMORS

The neurologic diagnosis formulated intra vitam had been that of a tubercle of the right cerebellar hemisphere; the tubercles lying on the lateral extremity of the inferior and superior semilunar lobules of the same side, the two of the left cerebellar hemisphere and the one on the left posterior bigeminal eminence had not been recognized. After reviewing the necropsy findings, was it possible to have suspected these other localizations? There was nothing favoring the hypothesis of multiple tubercles in the right cerebellar hemisphere; the absence of all symptoms attributable to quadrate and semilunar lesions did not allow any other diagnosis than that of tubercle of the cerebellar hemisphere. Neither were there any symptoms pointing to a lesion of the left cerebellar hemisphere; there were no hypotonia, asthenia, hypermetria, asynergy, etc. In fact, on the left side, we found a slight but evident hypertonia with exaggeration of the patellar tendon, phenomena which fitted in with a localization of the lesion in the cerebellar

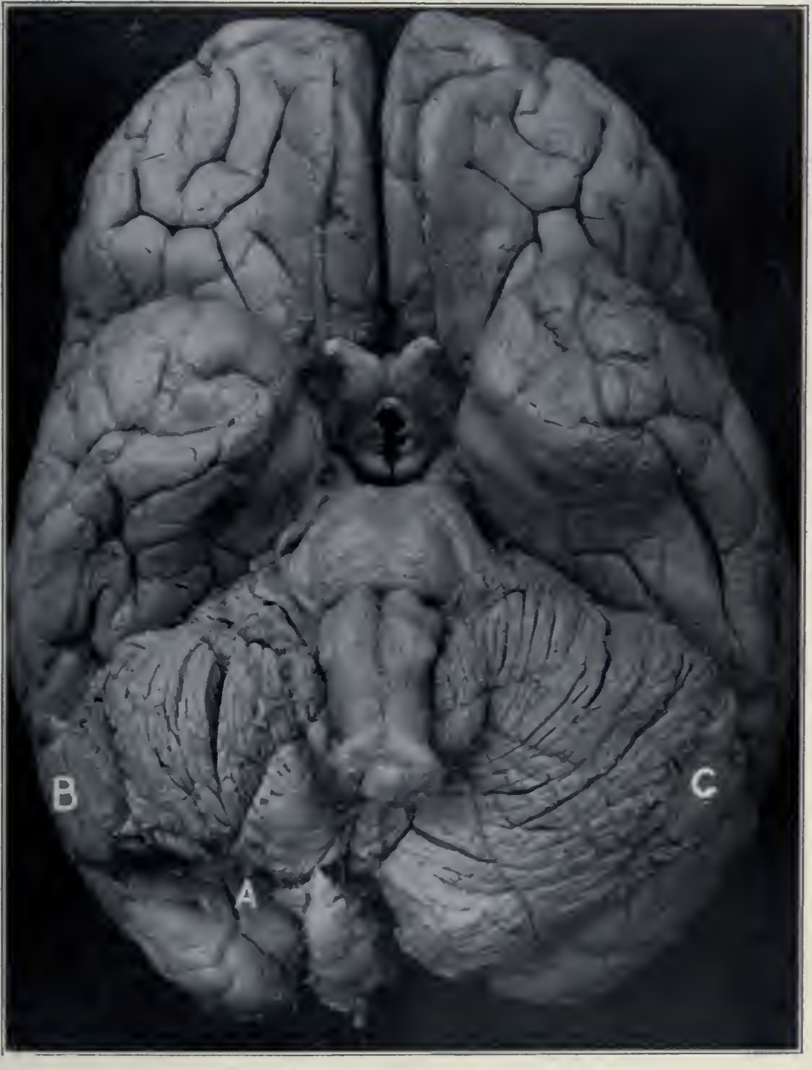

Fig. 3.—Multiple cerebral tubercles: (*A*) site of the tumor removed during the operation; (*B*) tubercle occupying the lateral extremity of the right inferior and superior semilunar lobules; (*C*) tubercle occupying the lateral angle of the left semilunar lobules in Case 2.

hemisphere of the opposite side. If, on the right side, the tubercles had caused a cerebellar syndrome, this was due to the fact that the tubercle of the quadrate lobe was not limited to the medullary substance alone, as on the left side, but had invaded a large part of the cortical tissues as well. It would seem, therefore, that cerebellar symptoms depend less on the lesion of the meditullum cerebelli than on that of the cortical portion of the cerebellar hemispheres.

One could not have had the faintest suspicion of the presence of a tubercle in the left lamina quadrigemina, all criteria for making such a localization being absent. There were in fact no pareses of the extrinsic eye muscles innervated by the third and fourth cranial nerves, no paralysis of associated movements of the eyes, no cerebellar ataxia. Only the bilateral hypo-acusia and almost complete pupillary rigidity to light could possibly have been laid to a lesion of the bigeminal eminences, but it would have been absurd to make such a localization on the basis of these two symptoms alone because the hypo-acusia appeared late and both could be explained on the hypothesis of a cerebellar localization with increased endocranial pressure. At any rate, the necropsy fully confirmed the absolute absence of localizing signs; the tupbercle, although occupying almost the entire left posterior bigemina and a portion of the anterior bigemina of the same side, did not impinge on the underlying tegmen mesencephali. It is known that in man the bigeminal eminences possess a rather limited physiologic importance and that symptoms provoked by a lesion of the same are essentially due to concomitant involvement of the underlying tegmen. As the latter was not involved in the tubercle which was growing dorsally rather than ventrally, the syndrome of neoplasms of this region was necessarily missing. Not few are the cases of bigeminal eminence tumors reported in the literature which did not, intra vitam, give rise to localizing symptoms. Among others may be mentioned Clarke's case in which a neoplasm the size of a nut occupied the velum medullare and lamina quadregemina without causing ophthalmoplegia or cerebellar ataxia.

My two cases once more demonstrate the enormous, almost insurmountable difficulties which confront a diagnosis of multiple cerebellar tumors, especially of multiple tuberculomas of the brain. I can add nothing to the infrequent and uncertain criteria of probability furnished up to date by other authors. Nevertheless, by taking into account the frequent multiplicity of cerebellar tubercles, it is the better advice, even when the symptomatology points toward a single tubercle, to be very cautious regarding the hopes of surgical intervention which, often, can only hasten a lethal exitus.

A STUDY OF THE INTERNAL STIGMAS OF DEGENERATION IN RELATION TO METABOLISM AND DISTURBANCE OF THE CEREBRAL CORTEX IN CHILDREN*

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AND

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PHILADELPHIA

It is admitted that specific diseases, such as heart disorders, tuberculosis and chronic interstitial nephritis, bring in their wake a series of well-defined and acknowledged mental symptoms, but it is yet to be generally accepted that arrested development in the intestines is a factor in retardation and the mental abnormalities of children, and that it is a causative factor in the mental disorders of adults.

Mental hygiene is taken by many of those who deal with its problems to refer solely to manifestations from the angle of abnormal social reactions. They accordingly set about bettering conditions by mental cures or by social adjustments. After two years' experience in a community clinic for psychopathic work, it appears to us that the percentage of cases in which the problem is so purely mental or social that it can be constructively altered by the psychanalytic method or by social adjustment is very small. It is true that all nervous and mental patients present to the public that phase of their malady which is a social service problem. The patients who come to a mental clinic are suffering from disorders which bring about a faulty social adjustment. Some are out of work, some are worn out from overwork, some lack common sense, some are feebleminded, some are neurotic, some are moral delinquents and some are instigators or victims of crime. This is the result of faulty relation between body and mind, and when the condition has become chronic little can be done. But in children who in physical degeneration are the prototypes of the chronic adult cases, we can, in many instances, correct the physical disorders accompanying the mental manifestations, and the latter will then disappear.

In addition to social eccentricities, there are certain external stigmas, such as outstanding ears, high palatal arches, or other well-known physical peculiarities more or less associated with the neurotic or mentally deficient person. These stigmas do not accurately indicate the condition, nor do they suggest any point of attack for improvement.

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* Read at the Forty-Seventh Annual Meeting of the American Neurological Association, Atlantic City, N. J., June, 1921.

The truly significant stigmas from the standpoint of helpful therapy we have found to be internal.

CLASSIFICATION OF PATIENTS

The Farmington Clinic classifies its patients not only by the usual mental and psychologic tests, which are of value, but also by the records of the fluoroscope. Among adults with mental disorders, there have been observed three distinct types of colonic deformity: the V-colon; the colon with dilated cecum and marked cecal stasis, accompanied by a spastic transverse colon; and general ptosis with stasis. In each of these, we have found prototypes in children. Insanity in adults can often be cured by treating these intestinal conditions, and children exhibiting mental or nervous symptoms, who by the use of the roentgen ray show these internal derangements, can often be brought to normal by gastro-enterologic treatment.

We find in these children precisely the same conditions as in adults. As early as the fifth year, we find ptosis which is not postural but developmental (Fig. 1). We find atonic stomachs down in the pelvis often associated with ptosis of the large and small intestines, all in the pelvis (Fig. 2); children with large angulated V-colons (Fig. 3); children with spastic constriction of the transverse colon, with resulting dilation of the cecum, and cecums holding residual masses for forty-eight hours, even when there have been two bowel movements a day, indicating true stasis.

In his recent book "Human Behavior," Dr. Stewart Paton says, "In infants and young children there are often definite disorders of digestion, which are not the cause but the product of inferiority. Emotional disorders are among the commonest signs of physical inferiority."

PHYSICAL STUDY AND TREATMENT

Whether the cause or the product of inferiority, these "disorders of digestion" can be so treated that not only their manifestations in the emotional states cease but the physical inferiority itself is amended also. The atonic stomach takes its proper position, the normal visceral relations are assumed and the nervous and mental symptoms disappear. If the first evidence of organ inferiority in a young child is indigestion, the place to begin to assist a normal growth development is the digestive tube, and the fluoroscope will show the weak point. The time to begin is at once, not waiting until the emotional exhibitions point to disturbance in the cortex. The cases cited hereafter show by the roentgen ray definite stigmas of degeneration in the digestive tube. The degeneration may be caused by organ inferiority or the inferiority may be caused by degeneration due to improper feeding from early infancy.

The approach to the physical study of patients at the Farmington Clinic is by the following avenues:

1. Morphology: The disease a particular body form is prone to.
2. Chemistry: The toxic products in blood, urine and stool.

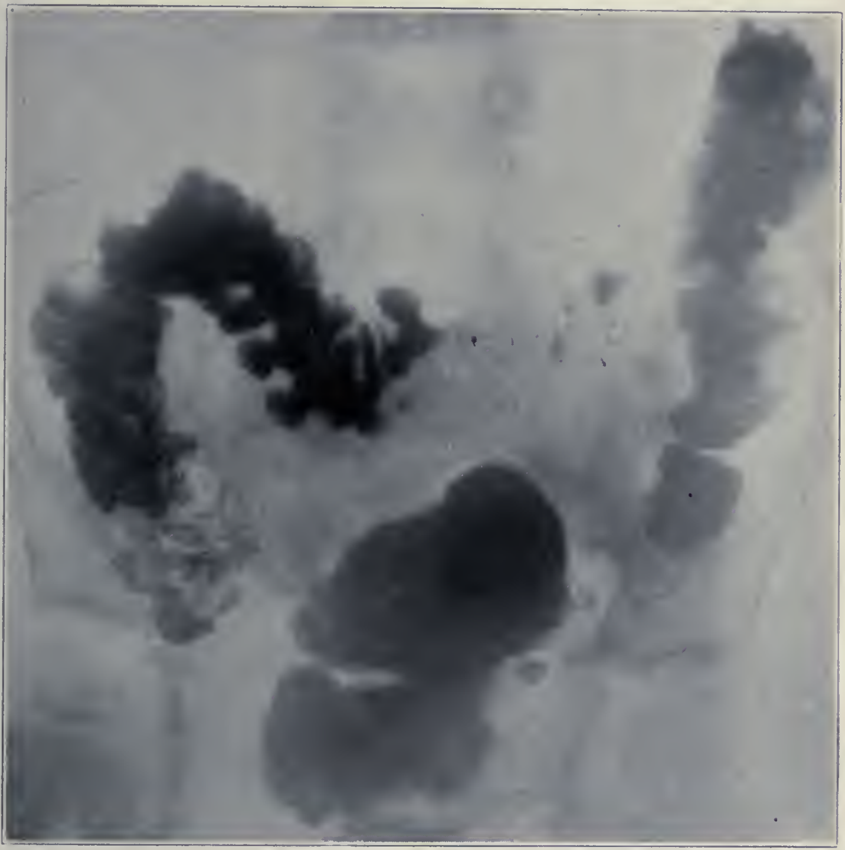

Fig. 1 (Case 1).—Tendency to ptosis at 5 years; diagnosis, mental retardation.

3. Physiology: The alterations in blood pressure, heart, muscle action, peristalsis, skin secretion.
4. Fluoroscope: Arrested intestinal development, stasis.
5. Protoscope: Infection and disorder in circulation in mucous membrane of bowel.
6. Intestinal Flora: Predominance of type of bacteria and products of digestion.

The effort is to establish the interrelation of the cerebral cortex with the sympathetic nervous system, the internal secretions and the digestive tube.

In the cases with anomalies of the colon, there is often a subinfection in the mucous membrane; but we find that there can be marked stasis without subinfection. There can be a bowel movement every day, and yet daily fluoroscopic observation will reveal that these movements are from twenty-four to seventy-two hours behind time. Neither constipation nor daily movement is indicative of the true condition of the colon. The character of the intestinal flora is significant and calls for study by various bacteriologic tests.

A case in point is that of Dan, aged 7 years, without ptosis or stasis, but with absence of colon bacilli, and an overwhelming number of gram-positive organisms and a high degree of acid secretion of the saliva. His mental condition was markedly subnormal, and he was given to frequent uncontrollable screaming fits and to prolonged giggling spells. The emotional symptoms disappeared after three months, following the reduction of the acidity and the implanting of cultures of colon bacilli in the bowel, normal bacterial proportions thus being produced. The mental condition showed marked improvement so that he is now having lessons suitable for his age and is well on the way to normal childhood.

OTHER FACTORS

There are other important underlying factors, such as lime deficiency, pancreatic infantilism, and dystrophies of the endocrine glands, the thyroid and pituitary being most frequently affected. These conditions are known in all well-equipped clinics, as are also the conditions in which poor circulation and respiration are responsible for dulness and retardation, and the group in which adenoids and tonsils play a large part. We do not believe that all forms of pathologic mental disorder can be assigned to these various groups, but we offer this paper and the cases which follow as the beginning of a study of the internal stigmas of degeneration; and we emphasize the types of physiologic factors that can be recognized and related to mental abnormality, especially stressing the gastro-enterologic study.

REPORT OF CASES

Case 1.—The patient, a boy, with a diagnosis of mental retardation, showed a tendency to ptosis at 5 years of age. He was nervous, difficult to manage and inattentive; backward, but not feebleminded. Roentgen-ray examination revealed that most of the large intestine was below the crest of the ileum.

Case 2.—A girl, aged 11 years, with a diagnosis of mental instability and marked retardation, who was barely able to do second-grade work in school, gave a history of constipation in infancy. She did not walk until 3 years of age, and she was very slow in talking and in cutting her teeth. Her conduct in school was marked by uncontrollable outbreaks of explosive wrath. There was a tuberculous heredity from both parents. During the pregnancy, the mother suffered from rheumatism and exhaustion.

Examination revealed abnormal reflexes, wet hands, poor circulation, and faulty coordination, resulting in an awkward gait. Fluoroscopic examination of the intestinal tract revealed ptosis with spasticity. The stomach was low in the abdominal cavity, the lower curve being within 4 inches (10 cm.) of the symphysis. The patient could not raise either the colon or stomach at will, but the whole colon was free and easily movable by abdominal pressure.

An abdominal belt was fitted and gastro-enterologic treatment was instituted. The physical health improved to a surprising extent; the nerves were more stable: the outbreaks of extreme excitability seldom occurred, and were easily controlled. The patient has caught up with her class in school.

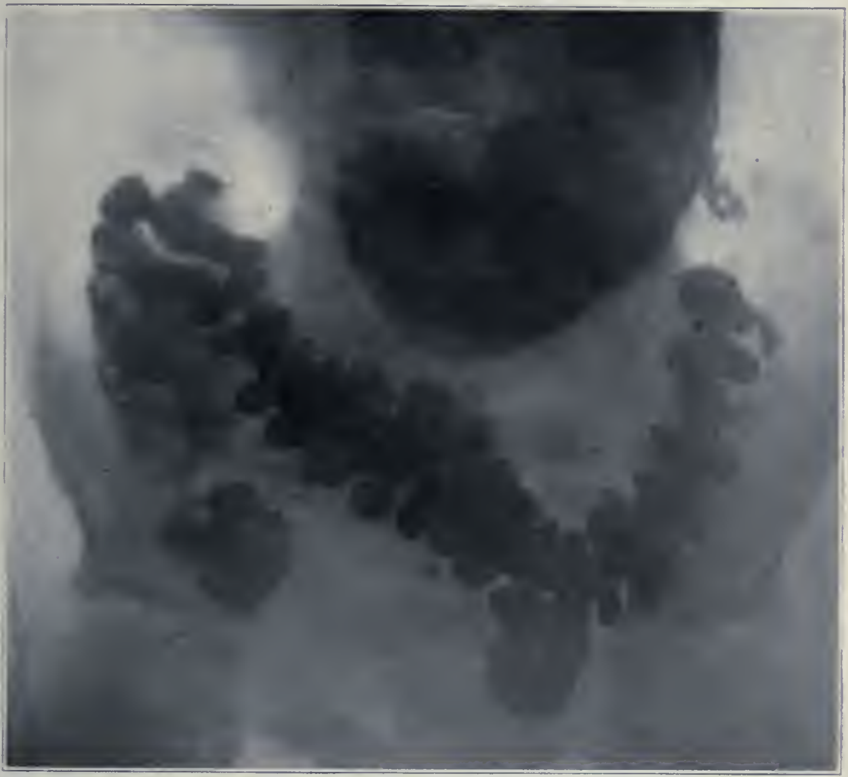

Fig. 2 (Case 2).—General ptosis and stasis, and atonic low stomach: diagnosis, mental instability and marked retardation.

Case 3.—A boy, aged 7½ years, with a diagnosis of dull, retarded psychomotor activity, had made no progress in school for eighteen months. His manner was entirely unresponsive, repeated stimulation being necessary in order to gain any reaction from him. There had been a period of constipation and vomiting between the third and fifth years of age; but the boy was at this time well-nourished and strong, and had a good appetite. The bowels moved daily without medicine.

Fluoroscopic examination revealed a V ptosis of the hepatic flexure, and a colon with general stasis. The patient was much improved by medical treatment. Improving the tone of the abdominal muscles helped to overcome the deformity in the colon. The stasis usually seen back of the loop is not shown in the accompanying roentgenogram.

We believe that the malformation of the colon in this case is an internal stigma of degeneration. Without fluoroscopic examination, it is not demonstrable. The loop retards the movement and creates stasis.

Case 4.—A boy, aged 16 years, with a diagnosis of arrested mental development, tall for his years, and 16 pounds (7.2 kg.) under weight, had an infantile body, very small testicles and wide hips, and the ends of the long bones were very much enlarged. There was throat and nasal obstruction and a marked constriction of the chest. His school record showed retardation at fifth-year level. He always played with younger children.

Fluoroscopic examination revealed many points of degeneration, anomalies in the bony frame, a small heart, and a general ptosis of the colon.

In a case of this sort, the ptosis is probably only a part of the whole degeneration process. There was no stasis and only a modicum of benefit could be expected from any treatment. The case is presented in order that it may be compared with the others cited. Here is definite disorder, the product of inferiority, whereas, in a great number of our cases, the conditions are functional and the child is not so definitely degenerative.

Case 5.—A boy, aged 16 years, with a diagnosis of beginning dementia praecox, had always been secretive and lonely, but had showed no mental peculiarity. He finished one year of high school with average marks. Since leaving school, a year previously, he had not worked steadily at anything. Six months before he came under observation, he began to refuse to go out, sat idle around the house all day, grew increasingly impudent and irritable, and developed the habit of masturbation to excess. In a few weeks, he had delusions, which changed from time to time; but at the present time he has been free from delusions for a month. He has insight into his mental condition.

The patient had chronic constipation. The roentgen-ray examination revealed ptosis of the colon, and stasis, after thirty hours, along the whole length of the colon. The cecum was enlarged and the transverse was spastic. The treatment was largely irrigation and elimination.

Case 6.—A girl, aged 9 years, with a diagnosis of mental instability, had had rickets at seven months, and acute attacks of pyelitis and cystitis, which recurred at intervals of from two to four months, caused by colon bacilli. The last attack had occurred two years before. The patient was very slow in developing, not walking until 2 years of age and talking in the third year. She had received careful medical treatment. The bowels were naturally constipated and needed constant watching. Thyroid had been given for two years, with fairly good results. The patient had always been extremely irritable.

Fluoroscopic examination revealed a cecum of large size and a spastic transverse colon. There was a forty-eight hour retention in the cecum and tranverse colon. The principle therapeutic point is to relieve the spasticity of the transverse colon.

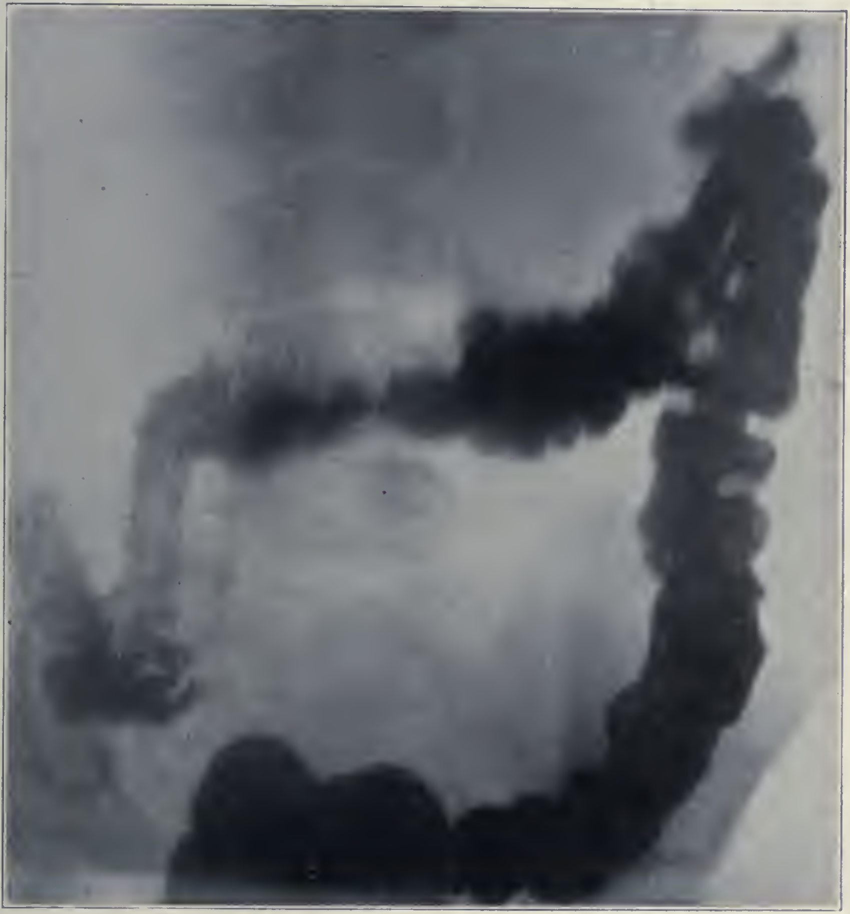

Fig. 3 (Case 3).—V-colon; diagnosis, dull, retarded psychomotor activity.

DISCUSSION

Dr. Edward B. Angell of Rochester called attention to his experience with similar methods of investigation in the management of the neurosis of adults for some years past.

In addition, however, to Dr. Ludlum's scheme, he had found a reaction of the urine in nervous cases very suggestive both as to cause and treatment of nervousness, in either the child or the adult.

He had heretofore called the attention of the American Neurological Association to the pigment ring obtained by underlying the urine with fuming nitric acid, as in the well-known Heller test. However, in place of the white albumin ring, one gets a well defined ring, reddish brown in color. Illustrations of this typical reaction in color can be found in one of the Osler memorial volumes.

He called Dr. Ludlum's attention to this because he believed it was suggestive at least of a defective catabolism, which, in fact, is largely the cause of nervous irritability either in the child or in the adult. He had not been able, however, to determine the chemical nature of this reaction, although he believed it was related to the purin content of the urine. It usually is associated with hyperacidity of the urine, a condition which aggravates irritability of the nervous system.

In the treatment of morbid neuroses, he had found great benefit, or even complete relief, by prescribing a dietary limited both as to proteins and sweets, and employing sodium bicarbonate and sodium salicylate in suitable doses. Dr. Angell said that a large number of children were overfed with meat. Indeed, in the average home, the housewife, never having learned the art of living, found it easier to cook meat than to provide a properly balanced diet, and so, naturally, used it too freely.

He had found that, in these cases of functional disturbances of the nervous system associated with mental depression, this mode of treatment was very efficacious.

Dr. Henry A. Cotton of Trenton said that there were two points that should be made in discussing the gastro-intestinal lesions in mental disorders. The first was that these lesions were not limited to any special types of psychoses, although they were found more frequently in the chronic or dementia praecox group. But the lesions occur also in the acute psychoses classified in the manic depressive group. Although the cases of the latter group show a tendency toward spontaneous recovery, only 84 per cent. do actually recover. In those who do not recover, severe lesions of the colon are present and probably have existed for some years. This is usually shown by the history of more or less vague gastro-intestinal upsets and habitual constipation, and marked delay in the passage of the test meal can be shown by the roentgen-ray studies of the intestinal tract.

These lesions have not been found so prevalent as suggested by Dr. Ludlum; for, out of 2,400 patients admitted in the last three years, only 150 have been operated on for the purpose of resecting the diseased portion of the colon.

The second point was in regard to treatment. In some of the mild types, undoubtedly, irrigation and other medical treatment was of value.

Among the first cases treated, an ileostomy or appendicostomy was done, but it was found that these palliative measures were of little value.

The reason for hesitating to operate on these patients had been the rather high mortality which formerly was the rule. In the earlier cases, the mortality rate was about 30 per cent., but this has been reduced to less than 3 per cent. In fact, in the last thirty cases of resection of the colon, only two patients have died, one from postoperative pneumonia, within twenty-four hours, and another with bronchopneumonia, four weeks later. This improvement was attributed to the administration of a specific antistreptococcus and anticolon bacillus serum, made from various strains of these bacteria isolated in the laboratory of the state hospital at Trenton.

Dr. Cotton was of the opinion that the point as to the combined toxemia, both from the bacterial toxins and the putrefactive products, the result of retention of the colon contents, was well taken, and that both factors were important in producing the cerebral toxemia.

These conditions in the colon have been found in a number of children, in some cases as early as 3 years of age. These lesions are prevalent in the defective and delinquent class.

In a number of such patients who have been operated on by Dr. J. W. Draper, arrest of the mental symptoms occurred following the removal of the infected colon. In many cases, the condition could be ascribed to a congenital malformation of the colon, which predisposed to infection later.

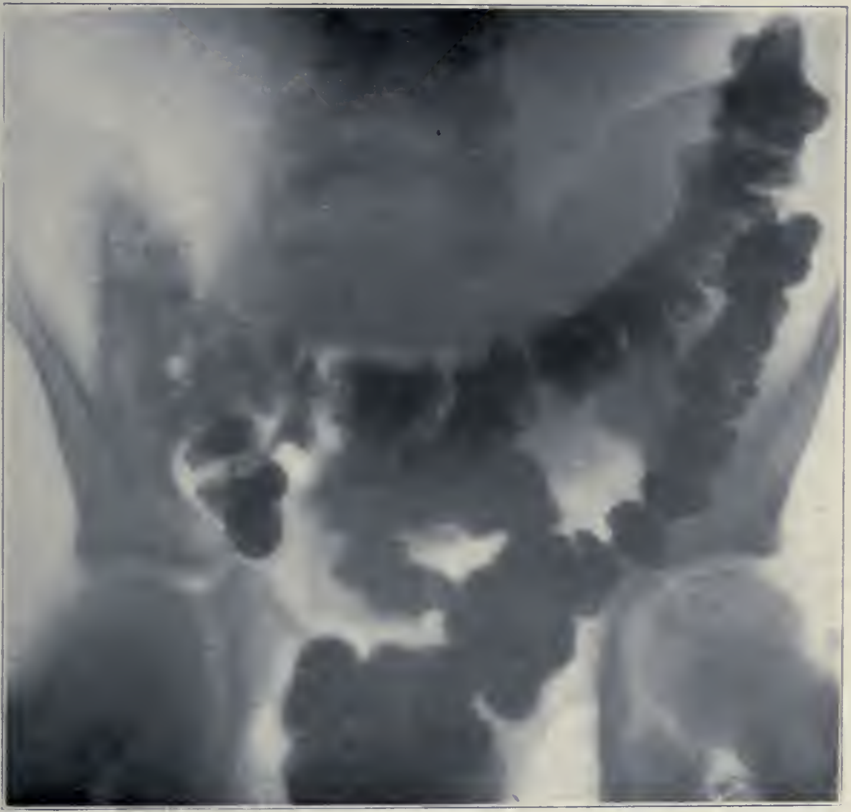

Fig. 4 (Case 4).—General ptosis of the colon; diagnosis, arrested mental development.

It was interesting to note that the morphology of the bowel was not so important as the function. If there were a ptosis or apparent abnormal condition, but no delay in the passage of the test meal, there would be no indication for operating; but if there were a distinct delay after forty-eight hours, there would be sufficient evidence for an exploratory laparotomy.

From the results of the surgical work at the state hospital, he was convinced that the subject of gastro-intestinal lesions in the neurotic and psychotic individual deserved more consideration than had been given to it in the past.

Dr. M. Alen Starr of New York said that, in an interesting paper which Dr. Cotton presented to the Dental Society of New York, in connection with the relation of disease of the teeth to insanity Dr. Cotton made the statement that, in the careful examination of the contents of the stomach, there was found almost uniformly an absence of hydrochloric acid, in the stomachs of insane patients from whom he had removed the teeth. That suggested that his findings were in conflict with those of Dr. Ludlum, who said that in the majority of instances alkaline treatment was of benefit. If there was absolute absence of gastric acid, found by one doctor, he could not reconcile that with the improvement in the cases given the alkaline treatment, found by the other.

Dr. Seymour De Witt Ludlum of Philadelphia said that from a previous discussion one would be impressed with the idea that all mental disease arose in the brain; and in a later session, that they arose in the stomach. Such divergencies of opinion were a cause of controversy.

In regard to Dr. Angell's criticism, Dr. Ludlum said that he had used his test, and it usually fitted in with the rest of the studies. He said that if the cause of the symptoms was eliminated, they would disappear.

Dr. Ludlum made it clear that he was not of the opinion that all forms of insanity had this condition as a basis, but he thought that it was the basis in a great many cases, and if the patients were treated by gastroneurologists and medical men who believed that the brain has something to do with the stomach, there would be some favorable results.

A NOTE ON THE PATHOLOGY OF THE CHOROID PLEXUS IN GENERAL PARALYSIS *

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BOSTON

The choroid plexus is made up of a mass of blood vessels surrounded everywhere by a layer of delicate connective tissue. This connective tissue layer is the basement membrane for the ependymal cells, which form the outer surface of the plexus, and which are continuous with the ependymal covering of the ventricular walls.

Two types of blood vessels make up the choroid plexus. One group has the usual structure of the arterial system, and lies in the midst of the plexus. Those of the second type are thin walled vessels, on which the ependymal layer with its underlying connective tissue, is applied, forming a finely villous structure.

The blood supply in man is obtained from the anterior choroid branch of the internal carotid and the posterolateral choroid, a branch of the posterior cerebral. The return of venous blood is through the choroid vein into the internal cerebral veins which join and form the vein of Galen (Boyd [1]).

According to Mestrezat [2] and others, the function of the choroid is that of elective filtration; dialyzation through a membrane which has the power of holding back almost all substances other than those immediately necessary for the functioning of nerve tissue. Von Monakow,[3] who has made a detailed study of its embryological development, classes the choroid plexus among the glands of internal secretion, and considers that its pathology plays an active part in schizophrenia; Mott also ascribes an internal secretory function. Tilney and Riley [4] speak of it as the choroid gland. Schmidt concludes from the difference of composition between blood and spinal fluid that the latter is a secretion and not a transudate. Barbé [5] has studied the permeability

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* From the Department of Neurosyphilis, Boston Psychopathic Hospital, Boston.

* This work was made possible through a grant from the United States Interdepartmental Social Hygiene Board, Washington, D. C.

[1] Boyd, W.: Physiology and Pathology of Cerebrospinal Fluid, New York, Macmillan Co., 1920.

[2] Mestrezat: Le Liquide Cephalo-Rachidien, 1912, p. 169.

[3] Von Monakow: Schweiz. Arch. f. Neurol. u. Psychiat. **4**:2, 1919.

[4] Tilney, F., and Riley, H. A.: The Form and Functions of the Central Nervous System, An Introduction to the Study of Nervous Diseases, New York, Paul B. Hoeber, 1921, p. 266.

[5] Barbé: Perméabilitié Physique des Plexus Choroides, Rev. Neurol. **27**: 314, 1920.

of the choroid plexus in subjects with various mental states, and in those without psychoses, by the use of a variety of fluids. He concludes that the passage of fluids through the walls varies according to the age of the subject, the final illness, the period postmortem and the fluid used in the test. The time is about the same in all patients without nervous or mental trouble; it is slowed in epilepsy, but general paresis appears to augment the permeability of the plexus.

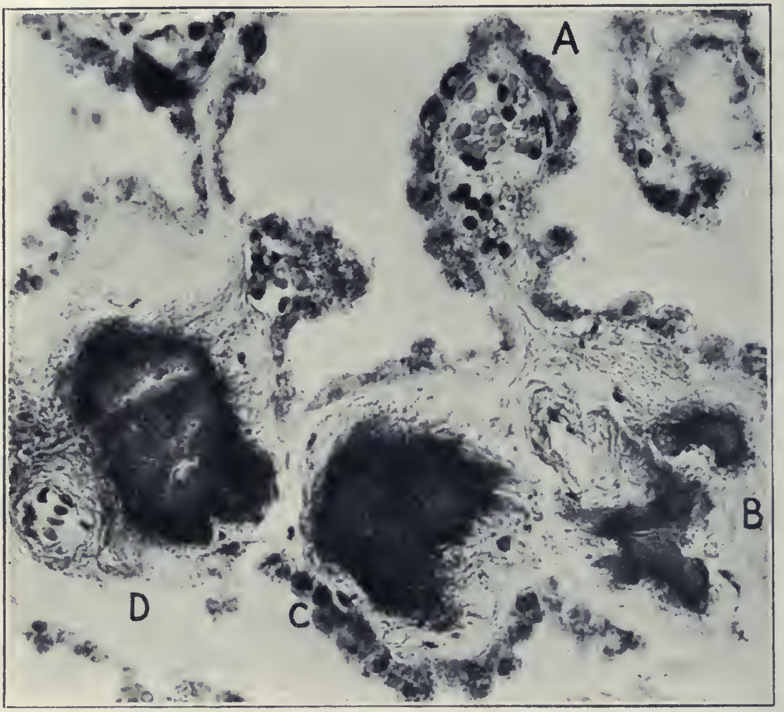

Fig 1.—*A,* relatively normal choroid villi; *B,* fibrous tuft with partial calcification; *C* and *D,* nearly complete calcification. Ependymal cells are present.

Kitabayashi,[6] working in von Monakow's laboratory, has made a rather extended study of the choroid plexus in mental disease. He found three types of alteration in his material.

1. Plexus changes, mainly of connective tissue (mesodermal) with secondary glandular alterations.
2. Gland parenchyma (ectodermal) changes most prominent with secondary proliferation or atrophy of connective tissue elements.
3. Both types of tissue about equally involved.

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[6] Kitabayashi: Schweiz. Arch. f. Neurol. u. Psychiat. **6:**154, 1920; **8:** No. 1.

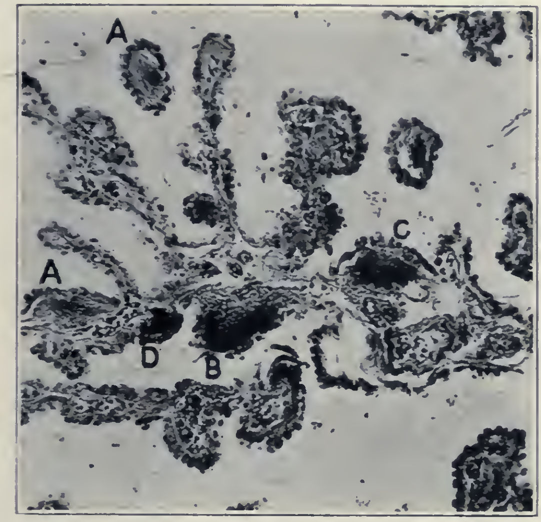

Fig. 2.—*A*, fibrous replacement of capillaries; *B, C, D*, calcification of fibrosed capillaries.

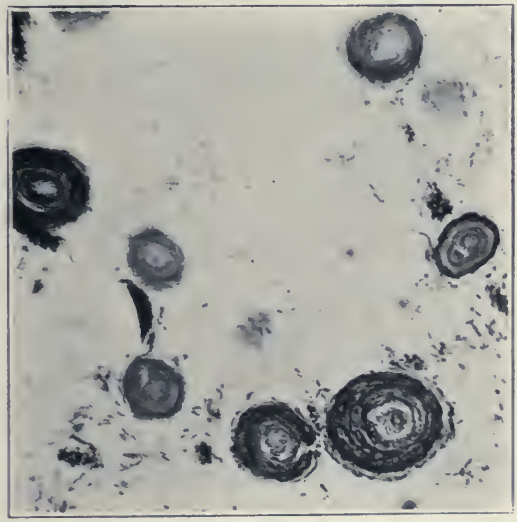

Fig. 3.—Calcareous granules; concentric formation; high power.

Two interesting papers have come from Obersteiner's laboratory—one by Yoshimura[7] on histochemical findings, which has no direct place in this consideration, and another by Imamura[8] describing and illustrating the formation of the calcareous granules. He concludes that a coagulated, homogeneous mass is first laid down between the connective tissue fibers; that the cells then proliferate in layers, one on the other, and within this body calcium salts are deposited.

The brains, from which was derived the material here commented on, were being studied from quite a different point of view, when a chance remark in a current medical journal, on the need of more work on the choroid plexus, suggested making use of the available choroid tissue. No exhaustive review of the literature has been attempted. A limited search, however, has shown that the choroid has by no means been neglected, but apparently books of reference fail to include the results yielded by the work of various investigators from time to time, and as a review of the literature is time consuming, studies fail to reach the attention of the reader of general medical publications.

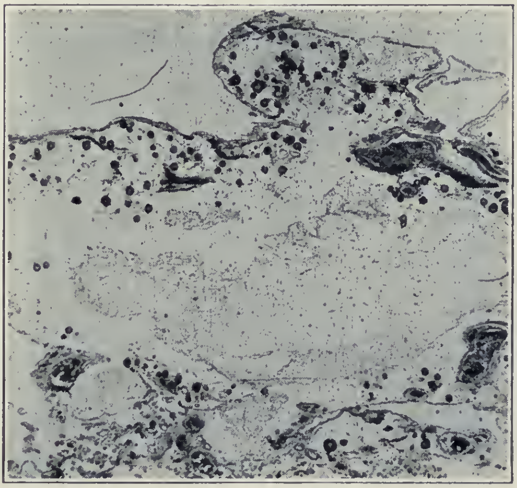

Fig. 4.—Cystic choroid plexus, showing entire loss of capillaries; made up chiefly of a loose reticulum in which are many calcareous granules; low power.

Although the choroid tissue studied was obtained wholly from general paralytic subjects, the findings were not peculiar to this condition.

The pathologic changes existing in the different specimens represent a progressive alteration. With little, if any, change in the walls of the nutrient arteries (Type 1), the connective tissue underlying the ependyma, and surrounding the villous capillaries (Type 2), begins to increase, encroaching gradually on the lumen of the minute vessel until it is entirely obliterated. This villus then appears as a tuft of fibrous tissue, without nuclei (1). It has not the concentric arrangement commonly seen in obliterative arteritis, but is merely a nodule of fibrous tissue. The delicate outline of the villus is lost, and then follows the deposit of calcium salts until a calcareous granule is formed, which, on section, presents the usual concentric pattern (2). When the fibrosis has gone on to an extreme degree the choroid appears merely as an elongated, cystic body with no suggestion of its normal villous structure (3). On section, the usual landmarks are found to be entirely lacking, and in their place is a loose meshed reticulum in which the encapsulated calcareous granules are held and through which the more or less normal arteries pass. The cyst wall presents the same basement membrane supporting still quite normal appearing ependymal cells, not markedly different from the appearance of those in the normal specimen surrounding the capillaries. In one instance, there was slight thickening of the basement membrane in which were many congested capillaries, a picture familiar in the ependymal surface

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[7] Yoshimura: In Obersteiner: Arbeiten **18**: 1909-1910.

[8] Imamura: In Obersteiner: Arbeiten **8**: 1902.

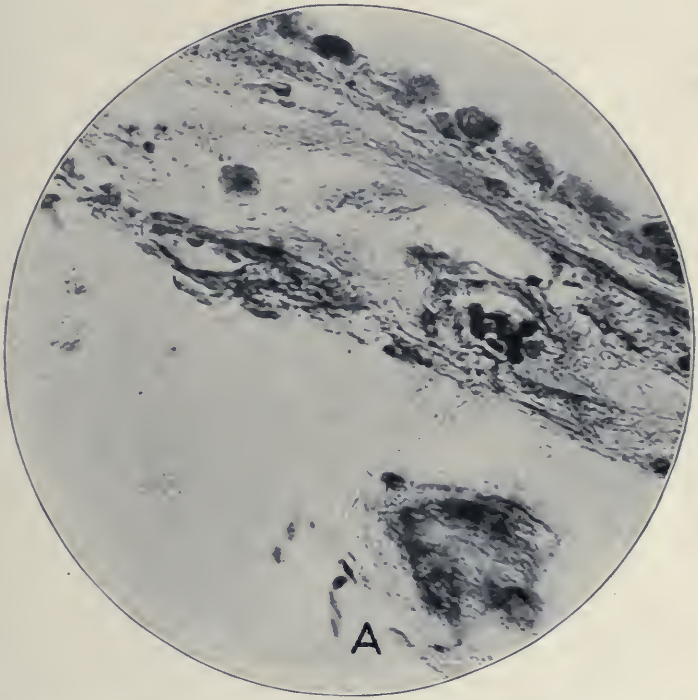

Fig. 5.—Thickened wall of cystic choroid, with calcareous granule in field *A*.

of the ventricles in ependymitis (4). The ependymal cells were still present in this case, and showed no notable morphologic change.

The question of the relation, finally, of the capillaries and the ependymal cells made this study interesting. In general paresis there is no lack of spinal fluid, generally considered as a product of the choroid plexus. On the contrary, dilated ventricles is one of the most common conditions in this disease, and is by many considered due to increased pressure of the fluid.

If the cerebrospinal fluid continues to appear as is evident in spite of the obliteration of the choroid capillaries, the source would not seem to be one of filtration, however qualified. On the other hand, is one justified in concluding that the persisting ependymal cells are capable of functioning in the rôle of gland cells without the presence of the capillaries with which they normally stand in relation?

SUMMARY

The choroid plexus is made up of numerous capillaries surrounded by a thin layer of connective tissue on which are the ependymal cells.

The choroid plexus is an important factor in the production of cerebrospinal fluid, either by means of selective filtration or by secretion.

In the sections studied, a progressive fibrous change was traced, beginning with general increase of connective tissue, followed by obliteration of capillaries, with formation of fibrous tufts, in which calcium salts are deposited, and final cystic condition of the plexus. At this stage the capillaries have entirely disappeared, but the ependymal cells remain and are little changed morphologically.

In view of these findings, what shall be concluded as to the relation of the capillaries to the production of cerebrospinal fluid, which here suffers no reduction in amount?[9]

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[9] In addition to the references given, the following may be of interest: Levinson, Abraham: Cerebrospinal Fluid in Health and in Disease, St. Louis, The C. V. Mosby Co., 1920.

A CONTRIBUTION TO THE MENTAL PATHOLOGY OF RACES IN THE UNITED STATES *

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NEW YORK

To those who believe with Kraepelin that the disposition of a people finds expression in its mental diseases, it would seem that investigations of the mental pathology of peoples and races might lead to some information as to the general characteristics of the peoples concerned. The character and degree of intelligence, emotional stability, morale, tendencies to criminalism and to inebriety, might be revealed by these measures. Such information might well be more definite than indicated by the actual number of cases found, as for each case pronounced enough to be called a disease there would be many borderline ones of the same category showing the same general trends. An excessive distribution in any community of any particular type of disease might well indicate the general mental level and trend of that community.

Obvious difficulties stand in the way of investigations of this kind. Intensive surveys are necessarily restricted to small groups, and are limited in their general application. The general statistics have never been compiled in a manner to throw much light on the subject. The neuropsychiatric statistics of the army afford an opportunity to analyze a large group of all kinds of neuropsychiatric defects and disorders which existed in the representative manhood of the country from 1917 to 1919. It is the purpose of this paper to set forth the results of the analysis of these cases as far as they concern certain foreign-born and native-born races.[1]

From them it appears that, with the exception of epilepsy, certain communities and certain races in the United States display wide variations in the distribution of one or another form of nervous or mental disorders found among them. For example, according to the statistics, the negro exhibits a tendency toward mental defect and away from every other neuropsychiatric condition, while the native-born Scot shows a tendency away from mental defect and toward alcoholism and certain other neuropsychiatric conditions. The widest variations occur in reference to mental defect and inebriety, and the chief value of this study concerns the variations found in respect to these two conditions.

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* Read at the Forty-Seventh Annual Meeting of the American Neurological Association, Atlantic City, N. J., June, 1921.

[1] The classification of races made use of is taken from the "Dictionary of Races," prepared under the direction of the Department of Immigration and published in 1910.

Some races and some communities adhere closely to the median or average. For example, the English show little tendency to vary from the established average. In view of the place the English hold in the world, there is nothing in the present statistics to justify the denial that the middle course, as far as the distribution of nervous and mental disease is concerned, may be the characteristic of the people which attains the most power in the end.

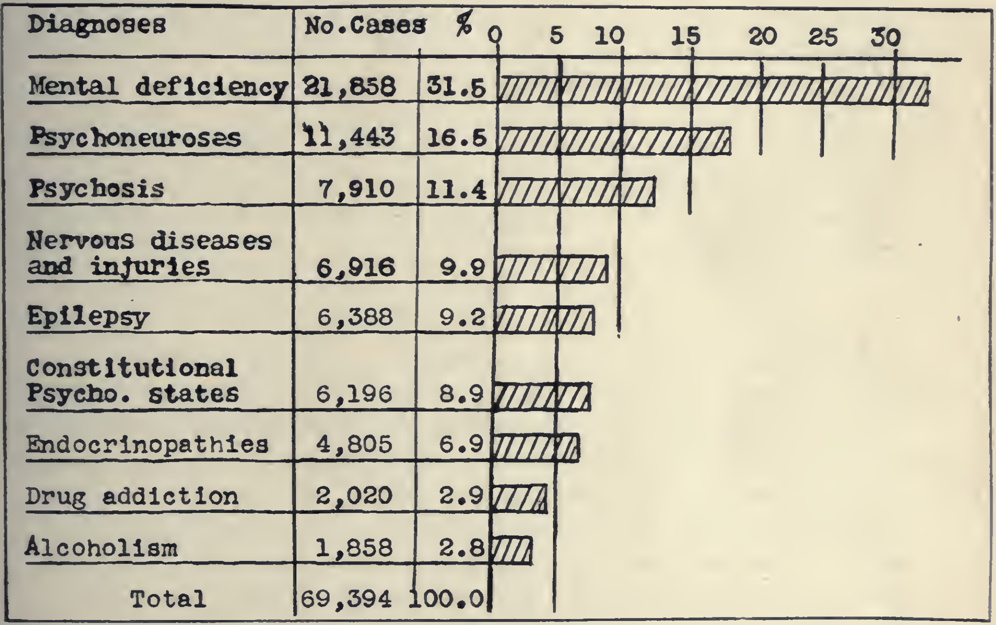
The social value of such information as the statistics yield would, of course, be enhanced by comparison with additional information concerning the circumstances of residence of these races in this country. To draw any final deductions it would be necessary to know the circumstances of immigration, the causes of emigration, class of immigrants, localities settled in here, and nature of occupations followed.

For example, the statistics indicate that the Italians and Mexicans in the United States are at a low level of intelligence and unable to compete with, let us say, the Scotch or the Irish. But they give no information as to whether these people represent an average of Italians and Mexicans living at home, or are merely representatives of inferior groups of Italians and Mexicans who, for some reason or other, have come here.

In comparing the native-born with the foreign-born, particularly, it would be valuable to know about the circumstances of immigration. The number of foreign-born peoples classified is limited, by necessity, to four races: Italians, Scandinavian, Irish and German. As between them and the native-born of the same race, certain definite variations in the distribution of neuropsychiatric defects are noticeable. For example, practically all native-born were found to be more addicted to drugs than the foreign-born. Residence in this country seems to foster a drug inebriety or to convert alcoholic inebriety into drug inebriety. Similarly, there appears to be a decrease in the number of cases of insanity among foreigners after residence in this country. Final explanation of these facts, however, must await a fuller knowledge of the circumstances under which a particular group of foreigners came to this country.

METHOD

The present statistics record only those cases which were identified at recruiting depot posts and at camps, namely, at the military points of enrollment. They record diagnoses or identifications, irrespectively of the military disposition made of the cases. They do not take into account the men rejected by local boards. Thus they cannot determine the percentage of neuropsychiatric cases to the total number of men examined. Information of this character as far as draftees are concerned, may be obtained in the reports of the Provost Marshal-General, and in "Defects Found in Drafted Men."[2] The method used here is that of distribution averages solely. It begins with 69,394 fully classified cases found among volunteers and draftees (Chart 1). This total of cases was divided into nine distinct clinical groups, and the percentages assigned to each group indicate how that group stood in relation to the total of neuropsychiatric cases found. Thus of all neuropsychiatric cases found in the home forces, black and white, 31.5 per cent. were cases of mental deficiency. This percentage represents the distribution average. As such differences existed between white men and negroes, when the distribution average of the United States was determined, it was determined separately for white and colored persons. By this method the average for mental defect in the United States was estimated from the distribution of mental defect among white persons and was found to be 29.2 per cent. A similar procedure was followed to determine the variations in the distribution of the various disease types found among the inhabitants of the different states and, as concerns the present article especially, among the members of certain foreign-born and native-born races. The total number of neuropsychiatric conditions found among a people, the Scotch, for example, was ascertained, and the percentage belonging to each clinical group



Diagnoses	No.Cases	%
Mental deficiency	21,858	31.5
Psychoneuroses	11,443	16.5
Psychosis	7,910	11.4
Nervous diseases and injuries	6,916	9.9
Epilepsy	6,388	9.2
Constitutional Psycho. states	6,196	8.9
Endocrinopathies	4,805	6.9
Drug addiction	2,020	2.9
Alcoholism	1,858	2.8
Total	69,394	100.0

Chart 1.—Distribution of neuropsychiatric cases.

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[2] Love and Davenport: Defects Found in Drafted Men, Government Printing Office, Washington, D. C., 1919.

was determined for the Scotch in the same way that it had been determined for the people of the United States as a whole. There was thus furnished a means of comparison between the distribution of each clinical group throughout the United States and the races which were classified. Startling variations were disclosed. This paper was written in the belief that these variations have something to offer toward the understanding of the characteristics of the different peoples concerned.

In interpreting the results two cautions should be kept in mind: First, that as all percentages are based on the total number of neuropsychiatric cases from each race, it is evident that when an excessive percentage is taken up by a single condition, the percentages of the other eight groups must be low, that is, a high rate in one group tends to lower the rate in all other groups.

It also should be noted that in reporting cases the examiners had to choose at times between two or more neuropsychiatric disorders. It is probable that constitutional defects were preferred to alcoholism or drug addiction. But this overlapping is not believed to have affected the rates to any great degree.

CLINICAL CLASSIFICATION

The graph (Chart 1) shows the nine clinical groups into which the whole material was divided. It is made up of all cases in which the information was sufficiently detailed to be classifiable, and the figures are only a little under the total number of diagnoses made.

Mental Deficiency.—No idiots reached the military posts, and so this group is made up of imbeciles, morons, those whose disease was on the borderlines and a small number in whom the degree of defect was not determined. About 90 per cent. of all those whose cases were identified were discharged from the service, and as the standard for discharge was fixed approximately at a mental age of 8 years, it is assumed that the bulk of the cases were at the 8-year-old level.

Psychoneuroses.—This group is composed of neurasthenia, hysteria, psychasthenia, stammering, enuresis, anxiety neurosis, traumatic cases and a few scattering and undiagnosed cases.

Psychoses.—In this group are included dementia praecox, manic-depressive insanity, general paresis and other psychoses associated with syphilis, mental deficiency and epilepsy.

Nervous Diseases and Injuries.—In this class are grouped the injuries of the nervous system, its organic diseases and such conditions as tremors, sciatica, tics, etc. Syphilis of the central nervous system was held responsible for nearly one half of these cases, and consequently a high distribution rate of this group in a people gives some indication of the frequency of syphilis in that people. If to them are added the psychosis due to syphilis (general paresis) and psychoses with cerebral syphilis from the preceding group the percentage of late nervous syphilis to the total of 69,394 cases would be approximately 3 per cent.

Epilepsy.—This includes both grand and petit mal attacks.

Constitutional Psychopathic States.—This group contains persons socially undependable as determined from personal examination and from past records classified into those with: inadequate personality, emotional instability, paranoid personality, criminalism, sexual psychopathy and a few other scattering forms. These persons are not feebleminded; on the contrary, they often have active intelligence, thus belonging to the groups of developed intelligence rather than to the mental deficiency group.

Endocrinopathies.—This group is much larger over the country as a whole than appears from the present statistics because under the names "effort syndrome," "cardiovascular" disturbances, etc., many cases fell exclusively to the cardiovascular examiners. The cases given here include those in which were symptoms of great nervousness, combined with definite lesions referable to the endocrine glands. In 93 per cent. of the cases the gland at fault was the thyroid.

Alcoholism and Drug Addiction.—Alcoholism in these statistics implies a chronic intoxication so profound that the person was, for the most part, beyond reconstruction for military purposes. Drug addiction, while allied to alcoholism as a form of inebriety, is subject to wide variation due to local conditions. It will be observed that the number of drug addicts and of alcoholics is practically the same. It should not be inferred, however, that these two disorders are of equal social importance, for that is far from true. The majority of intemperate men were accepted for service and made good. No medical record was kept of their habits. Records were kept only of the more or less permanently incapacitated alcoholic men. Quite the contrary was true of the drug addicts. They have always been looked on with disfavor by military authorities, and few were retained.

MENTAL DEFECT THE PIVOTAL POINT

Mental defect being the most widely distributed condition and the one most directly concerned with the question of general intelligence becomes naturally the pivotal point of the present discussion. It is assumed to be a distinct clinical entity, classifiable and distinct from insanity or any other of the different neuropsychiatric conditions.

It is the result of a failure of development of the mentality up to a capacity which, as we are dealing only with adults, we may call adult capacity. The normal of adult capacity has been roughly established by psychologic tests among civilized people. It is still unsettled whether or not this standard would be the same for primitive races as for cultured ones, that is, whether or not an average child of a savage, if from infancy it were given the same advantages as, let us say, the average French or English child, would develop into an adult with the average intelligence of a Frenchman or an Englishman. From the statistics which relate to two so-called primitive races, the African and the American Indian, it appears that the primitive could not under any present circumstances attain the average intelligence of cultured races. This appears to be so, not because there is any detailed information as to the potentiality of the primitive mind, but because mental deficiency is so profusely distributed among Africans and American Indians that their average intelligence must be inferior to that of average European intelligence.

At this point arises a question, and one that cannot be answered from the data on hand: What does excessive mental defect in a race mean? Is it a biologic condition marking the race as being in an early phase of development and establishing a level of intelligence more or less normal for the particular phase of evolutionary development in which the race finds itself, or does it mean that the race has been brought back to a regressive phase through the unrestricted interbreeding of mental defectives? That Caucasian strains can be reduced to low levels of intelligence we know from observation of communities in which the continual interbreeding of mental defectives has brought about that result. Is it possible that in a race we call primitive, like the negro race, a similar thing has occurred so that the backwardness is the result of some such racial setback?

The distribution percentage of mental defect is taken as an index of general intelligence, because when this distribution is excessive, the average intelligence can hardly fail to be lowered. It is lowered not only by the actual mental defectives, but by the number of dull people which the existence of mental defect implies, for it is estimated that for every case of mental defect of the 8-year-old mentality standard, there are at least ten cases of backward or retarded mentality.

An example will make this plain: Vermont[2] showed among its draftees 30.90 mental defectives for every 1,000 men examined. What does this indicate about that community? As mental defect shows no great predilection for either sex, it means that had females been included in the draft restriction, the rate of 30.90 would have been maintained for both sexes in the given age period. As mental defect shows no special predilection for the age period from 20 to 30, it means that this rate would maintain for the whole population at all ages. It would, therefore, apparently be safe to assume that there are at least thirty defectives per thousand in Vermont of the 8-year-old mentality type, and 300 per 1,000 of backward or retarded persons—persons of distinctly inferior intelligence. In other words, nearly one third of the whole population of that state is of a type to require some supervision and special educational facilities, and even then they cannot attain the average intelligence of cultured races.

In addition to the lowering of the general intelligence brought about by an overproportion of mental defectives plus the dullards who are always found with them, the outlook for the general intelligence is further impaired by the reduction in the chance of the appearance of persons of superior intelligence with the qualities of leaders.

When countries and especially when races are compared, the significance of a high ratio of distinctly inferior persons in a community becomes apparent. For example, the American Indian presents among his nervous and mental disorders a mental deficiency distribution rate of more than double, and the African a rate a little less than double, that of the distribution rate among white persons over the whole United States. This in itself is enough to explain the inability of the two races to compete with the average American. The Mexicans living in the United States present an even higher distribution rate for mental defect (66.9 per cent.), but concerning the Mexicans in general, in fact concerning all races which may have immigrated here within recent years, we can draw no such general conclusions as we can about the indigenous Indian and negro races. Concerning the foreign races which present a high distribution rate for mental defect, such as the Slavs (37 per cent.) and the Italians (32.7 per cent.), it can only be said that the ones living here now are distinctly below the average United States intelligence. It would be impossible to infer that these races at home present the same degree of mental inferiority; it may be that these countries sent us a high proportion of defectives and that these have intermarried.

Throughout the present material, mental deficiency shows significant correlations with the other neuropsychiatric conditions, and these correlations throw some light on the extent and quality of the intelligence of the people concerned.

As concerns psychoses or mental disorders, it might be assumed that these would be less likely to occur when there was a high rate for mental deficiency. With the exception of the toxic psychoses, the existence of a mental disease implies a developed intelligence, a kind of intelligence that would possess imagination, ideas, a certain quickness in mental processes. As is well known, distinct types of psychoses are practically unknown in childhood, the period before the intelligence is fully developed. The hypothesis that mental disease implies a developed intelligence and so would be less frequent among people in whom the intelligence is underdeveloped is borne out by the accompanying tables. Nineteen states exceeded (Table 1) the United States mental deficiency rate of 29.2 per cent., and showed among themselves an average of mental defect of 39.3 per cent. But the insanity rate was below the United States rate in these nineteen states, being particularly depressed in the states with high rates for mental defect: Arkansas, Kentucky, Maine, New Mexico, North Carolina, Tennesee and Virginia. The same correlation holds true for the five native-born races (Table 2) which exceed the United States rate of 29.2 per cent. for mental defect (with the exception of the Slavonic), namely, the Africans, American Indians, Italians and Mexicans.

TABLE 1.—Distribution Rates in Nineteen States in Which the United United States Mental Deficiency Rate of 29.2 Per Cent. Was Exceeded

		Percentage of Total Cases from Each State								
	Number Classified	Mental Deficiency	Psychoneuroses	Psychoses	Neurologic Conditions	Constitutional Psychopathic States	Epilepsy	Endocrine Disturbances	Alcoholism	Drug Addiction
U. S. average......	...	29.2	17	12.1	10	9.7	8.6	7.4	3.5	3
Alabama..........	397	36.0	20.1	11.7	9.9	7.3	9.3	4.8	0.6	1.2
Arkansas..........	384	43.7	21	9.1	7.2	6.4	8.4	1.4	0.2	2.6
Florida...........	152	31.1	18.4	14.5	9.2	8.8	11.2	3.5	0.4	2.9
Georgia..........	511	33.3	13	13.4	11.5	11.8	7.9	6	1	2.5
Kentucky..........	771	41.1	14	6.9	11.6	9.4	8.8	4.2	2.2	1.2
Maine.............	202	51.5	13	7.7	5.4	8.9	9.2	0.5	2.5	1.3
Maryland..........	396	44.9	13.3	10.5	7.6	10.7	4.5	4.4	3	1.6
Mississippi.........	308	35.4	23.2	9.8	8.3	6.6	11	2	0.7	3.1
Missouri...........	922	33.8	15.9	8.5	11.4	9.3	6.3	8.5	3.4	3
New Mexico........	94	41.4	10.6	8.4	11	9.3	12.8	5.3	0.9	0.4
North Carolina....	651	46.7	17.7	8	6.6	3.9	9.6	6.1	0.7	0.7
North Dakota.....	101	38.5	14.1	12.6	9.2	10.3	8	3.8	3.1	0.4
Oklahoma.........	398	33.3	15.5	11.8	12.7	6.7	6.7	4	2.3	7.4
South Carolina....	318	43.4	19.6	7	8.2	4.1	8.9	6.1	1.1	1.9
South Dakota.....	101	33.1	14.4	10.5	16.1	3.9	6.6	12.8	2.3	0.3
Tennessee.........	570	43	14.3	9.6	11.9	3.8	8	5.1	0.8	3.5
Vermont...........	38	33.6	16.8	13.3	10.6	10.6	8.9	3.5	3.5	0
Virginia...........	656	45.5	12	9.2	7	7.4	5.8	10.9	1	1.2
West Virginia.....	469	38.6	12.6	8.2	9.1	7.8	6.3	15.7	0.7	1.1

TABLE 2.—Distribution Rates in Five Native-Born Races in Which the United States Mental Deficiency Rate of 29.2 Per Cent. Was Exceeded

		Percentage of Total of Each Race								
	Number Classified	Mental Deficiency	Psychoneuroses	Psychoses	Neurologic Conditions	Constitutional Psychopathic States	Epilepsy	Endocrine Disturbances	Alcoholism	Drug Addiction
U. S. average......	...	29.2	17	12.1	10	9.7	8.6	7.4	3.5	3
African............	8,406	48.3	13.1	6.6	9.5	3.1	13.3	3.5	0.3	2.3
American Indian..	124	62.9	4.9	4	4	8.9	7.3	2.4	2.4	3.2
Italian.............	2,456	32.7	18.1	9.7	7.8	9.3	12.9	3.8	0.6	5.3
Mexican...........	384	66.9	4.2	4.7	5.7	3.9	11.7	3.4	0	0.5
Slavonic...........	2,488	37	15.3	14.4	7.3	10	6.6	5.7	3.1	1.2

The converse of this correlation between mental defect and insanity appears in twenty-five states (Table 3) which showed an increase in the insanity distribution rate. Of these, North Dakota alone showed an increase in the mental deficiency rate. The same relation holds true for eight of the fifteen classified native-born races which show an excess distribution of insanity (Table 6), with the exception of the Slavs. The distribution average of these nine races was 12.3 per cent. for psychoses and 21.7 per cent. for mental deficiency. An isolated example of the variations between mental deficiency and insanity is shown in the case of Florida. In that state the over average mental deficiency rate concerns the white people only—among Florida negroes it was 11.5 per cent., or 17.7 per cent., below the United States rate for white people. But the Florida negroes show an insanity rate of 13.8 per cent., which exceeds the United States distribution for insanity in negroes by 7.3 per cent.

TABLE 3.—Distribution Rates in Twenty-Five States in Which the United States Rate of 12.1 Per Cent. Was Exceeded (Whites)

		Percentage of Total Cases from Each State								
	Number Classified	Psychoses	Mental Deficiency	Psychoneuroses	Neurologic Conditions	Constitutional Psychopathic States	Epilepsy	Endocrine Disturbances	Alcoholism	Drug Addiction
U. S. average......	...	12.1	29.2	17	10	9.7	8.6	7.4	3.5	3
Arizona............	20	16.7	15	12.5	18.3	11.6	10.8	6.7	5	4.2
California.........	297	17.4	22	16.7	12.2	12.7	7.7	2.7	6	3.3
Colorado..........	70	14.4	28.4	18.2	10.7	9.5	11.8	6.4	2.1	2.1
Connecticut.......	97	15.9	26.7	17.8	7.7	10.3	10.6	3.1	5.7	2.9
Florida............	71	14.5	31.4	18.4	9.2	8.8	11.2	3.5	0.4	2.9
Georgia............	205	13.4	33.3	13	11.5	11.8	7.9	6	1	2.5
Idaho..............	42	25.4	26.7	10.3	8.5	6.7	7.9	14.5	0.1	0
Illinois............	546	13.8	19.9	20.7	10.7	9.1	8.3	9.8	7	1.5
Iowa...............	155	16.4	25.3	17.8	9.9	9.3	8.4	8.2	2.2	2.6
Massachusetts.....	224	14.4	25.7	18.1	2.7	12.2	10.4	1.7	8.8	2.7
Michigan..........	288	13.5	29.2	12	11	11.7	8.6	11.2	2.3	1.1
Minnesota.........	165	14	22.2	19.5	10.9	7.1	7.8	12	4.9	2.2
Montana..........	56	20.8	16.7	16	11.2	8.9	11.9	7.8	3.7	3.7
Nebraska..........	77	15.5	25.1	14.7	12.9	9.4	7.6	10.6	1.8	2.6
Nevada............	11	18.3	18.3	11.7	18.3	6.7	8.3	1.7	18.3	1.7
New Jersey........	191	13.4	27.5	16.6	6.8	11.2	12.6	5.7	3.6	3
North Dakota.....	33	12.6	38.5	14.1	9.2	10.3	8	3.8	3.1	0.4
Ohio...............	427	13.3	23.9	19.7	10.9	8.6	7.7	12.8	2.8	2.7
Oregon............	60	19.7	18.1	19.1	8.9	16.5	9.5	2.3	0.3	2.6
Texas..............	285	17.5	25.5	14.8	6	8.8	13.5	5.3	1.4	4.1
Utah...............	28	18.6	20.5	19.2	12.3	12.6	7.9	4	3.3	7.9
Vermont...........	15	13.3	33.6	16.8	10.6	10.6	8.9	3.5	3.5	0
Washington.......	78	17.7	28.6	14	8.2	9.5	7.5	9.3	1.4	6.8
Wisconsin.........	170	12.6	27	19.2	11.6	6.3	6.8	12.6	3.9	0.7
Dist. Columbia....	32	19.9	16.1	23.6	14.3	8.7	6.2	6.2	3.7	2.5

Between mental deficiency and alcoholism there seems to exist a very definite antagonism in that the two conditions do not exist in greatest abundance in the same communities and among the same kind of people. When the rate for one rises, the rate for the other falls. Of the nineteen states (Table 1) with an excess of mental deficiency, not one has an excess distribution of alcoholism, and in these nineteen states the average for alcoholism is 1.6 per cent. as compared with

3.5 per cent., the United States average. Conversely, seventeen states exceeded the United States average for alcoholism by 3.5 per cent. A similar antagonism is observed in the different races.

None of the five native-born races (Table 2) which exceed the United States rate for mental deficiency attains the United States alcoholic rate of 3.5 per cent. Conversely, none of the native-born races—the Hebrew, Irish, Scotch, Greek and Spanish—which exceeds the United States alcohol rate, attains the United States mental deficiency rate of 29.2. Similar conditions prevail in the foreign-born races classified.

TABLE 4.—DISTRIBUTION RATES OF NEUROPSYCHIATRIC CONDITIONS AMONG FOUR DIFFERENT RACES, WITH COMPARISONS BETWEEN THE NATIVE-BORN AND THE FOREIGN-BORN

		Percentage of Total of Each Racial Group								
Race	Number Classified	Mental Deficiency	Psychoneuroses	Psychoses	Neurologic Conditions	Constitutional Psychopathic States	Epilepsy	Endocrine Disturbances	Alcoholism	Drug Addiction
U. S. average......	...	29.2	17	12.1	10	9.7	8.6	7.4	3.5	3
Italians:										
Native born.....	2,456	32.7	18.1	9.7	7.8	9.3	12.9	3.8	0.6	5.3
Foreign born....	2,042	32.5	19	9.3	8	9	15.0	4.4	0.4	2.5
Scandinavians:										
Native born.....	1,261	23.6	17.5	17.3	10.1	8.4	6.8	10.5	4.3	1.9
Foreign born....	454	18.8	15.3	21.5	12.2	9.1	6.7	8.9	7.1	1.1
Irish:										
Native born.....	4,505	21	14.8	11.8	11.6	11.1	8.2	6.4	11.2	5
Foreign born....	413	28.4	15.7	20.1	10.9	6.6	7.9	4.8	22.8	0.9
Germans:										
Native born.....	4,378	28.0	17.5	12.7	9.6	9.9	7.4	10.9	3.0	1.6
Foreign born....	188	25.7	15.5	21.4	10.7	6.9	8.6	7.5	2.7	1.6

In the states in which the distribution of mental deficiency is over average, there is practically no change in the rate for epilepsy; in the races a slight increase in the rate for epilepsy occurs. As concerns the psychoneuroses, states and races with plus mental deficiency show a slight decrease. With some exceptions, constitutionally psychopathic states tended to be below the United States average in both the states and the races which showed an excess of mental deficiency. It would, therefore, seem that an excess of mental deficiency in a people assures an amount of alcoholism, insanity and psychopathic states below the average, and conversely, that when these conditions are in excess mental deficiency recedes.

The foregoing variations apply to the fifteen classified races in the United States as shown in Table 6. Table 4 shows four of them, divided as was possible, into native-born and foreign-born.

MENTAL CONDITION OF VARIOUS RACES IN THE UNITED STATES

African Race.—(Number classified, 8,340.) The most striking characteristic of the negro is the wide distribution of mental defect

(48.3 per cent.) and the low distribution of alcoholism. In negroes the mental deficiency rate exceeded the United States rate for white people by 19.1. The southern states are high in mental defect, but the negro cannot be held entirely responsible for this as in many southern states the mental defect for white people exceeds that for negroes, as shown in Table 5.[3]

It will be observed that in these southern states the average mental deficiency rate for the white population is considerably higher than the United States average for white people, 29.2 per cent., and that the average rate for the negro is considerably below the United States average for the negro, 48.3 per cent. In Florida, Georgia, Kentucky, North and South Carolina and West Virginia there are proportionately more white than colored mental defectives.

TABLE 5.—MENTAL DEFICIENCY DISTRIBUTION RATES FOR WHITE AND FOR BLACK POPULATION IN TWELVE SOUTHERN STATES

	Negroes	Whites
United States average	48.3	29.2
Alabama	66 4	36
Florida	11.5	31.1
Georgia	31.7	33.3
Kentucky	38.5	41.1
Louisiana	48.3	28.8
Mississippi	44.6	35.4
North Carolina	40.8	46.7
South Carolina	40	43.4
Tennessee	71.8	43
Texas	33.4	25
Virginia	48.6	45.5
West Virginia	37.5	38.6

Some students seem to think that the backward condition of the negro is the result of his environmental conditions; that if he were given opportunity he could approximate the Caucasian standard of mentality. The present statistics do not bear out such an opinion.[4]

It is true that in certain northern states the mental deficiency rate for negroes is much lower than in the south—indeed, in New Jersey it is lower for negroes (21 per cent.) than for white people (27.5 per cent.). The apprentice system for slaves prevailed in New Jersey until 1863. This system provided supervision and care and may help to explain the present superior quality of negroes in New Jersey. Also one must bear in mind that mental defect is a social weed, tending to spread; one must also bear in mind the important factor of migration. The brighter and more enterprising members of rural communities have for years been pushing out for the large cities, leaving the dullards and defectives on the plantations and farms. It seems, therefore, possible that the higher mentality of northern negroes is not the result of environmental conditions, but is due to the fact that they came of better stock in the first place, the northern negro population consisting of slaves who had had wit enough to escape, or servants selected with greater care: that the low mentality of the southern negroes is due to their staying together and interbreeding.

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[3] No cases of mental defect among negroes, or too few to classify, were found in California, North Dakota, South Dakota, Oregon, Utah, Vermont, Washington and Wyoming. This simply means a small negro population as these states together gave a total of forty-five psychiatric cases among the negroes.

[4] According to Trabue, intelligence rating taken of drafted negroes from Louisiana and Mississippi, and of white men from Illinois, Wisconsin and Minnesota, showed that only 0.2 per cent. of the negroes from Louisiana and 0.5 per cent. of the negroes from Mississippi were graded as superior, while 10.7 per cent. of the white men had this standing. At the other extreme only 7.4 per cent. of the white men had a grade of inferior or very inferior, while 52.9 per cent. of the Mississippi negroes, and 63.3 per cent. of the Louisiana negroes, had this low grade. Natural History **9**: No. 6, 1919.

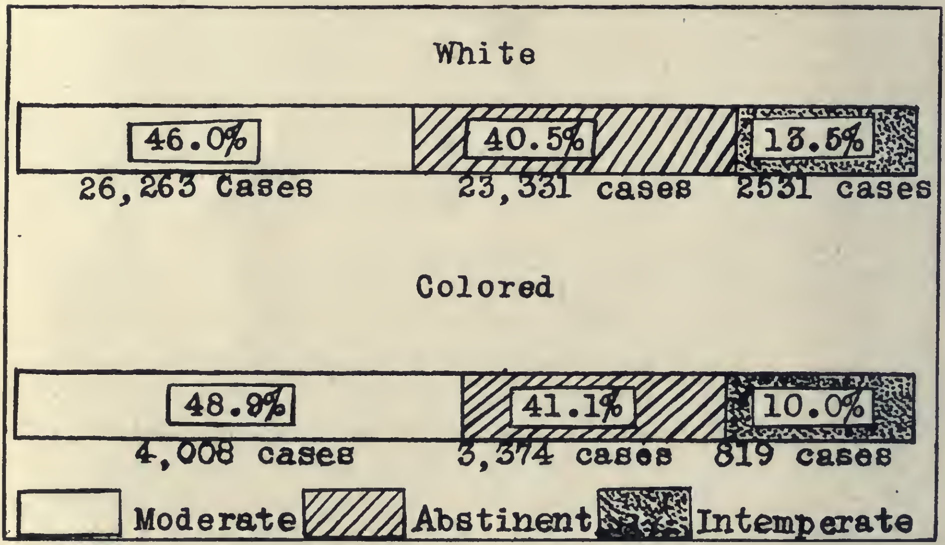

Chart 2.—Alcoholic habits of white and colored neuropsychiatric patients.

In contrast to the high distribution of mental deficiency among the neuropsychiatric conditions of negroes, alcoholism among them practically did not exist. There were only twenty-nine cases in all. This absence of the disastrous effects of intemperance contradicts the current belief that the ravages, which result from the abuse of alcohol, are particularly severe among primitive races. Chart 2 shows the percentage of distribution as to the use of alcohol among white and black persons with neuropsychiatric conditions. It will be observed that the negroes have a slight advantage. It would seem, therefore, that the negro can be practically as intemperate as the white man, without paying the same penalty for it. On the other hand, he is much more susceptible to venereal diseases; 57.8 per cent. of all negroes gave a history of venereal infections of some sort, while only 22.3 per cent. of white people gave such a history. In view of this great disparity, and since the white people actually drank more than the negroes, it would seem that some modification would have to be made in our views of the prime importance of alcohol as a factor in the spread of venereal diseases.

A similar, though less marked resistance to the involvement of the central nervous system by syphilis is shown by the negro. Among neuropsychiatric cases the history of preceding syphilis was more than three times as frequent in negroes as in white persons, but the involvement of the central nervous system by that disease was about equal in the two classes.

TABLE 6.—DISTRIBUTION RATES OF NEUROPSYCHIATRIC CASES AMONG FIFTEEN CLASSIFIED NATIVE-BORN RACES

		Percentage of Total of Each Race								
Race	Number Classified	Mental Deficiency	Psychoneuroses	Psychoses	Neurologic Conditions	Constitutional Psychopathic States	Epilepsy	Endocrine Disturbances	Alcoholism	Drug Addiction
U. S. average......	...	29.2	17	12.1	10	9.7	8.6	7.4	3.5	3
African............	8,406	48.3	13.1	6.6	9.5	3.1	13.3	3.5	0.3	2.3
American Indian..	124	62.9	4.9	4	4	8.9	7.3	2.4	2.4	3.2
Dutch..............	331	26.2	14.9	13.1	11.6	10.1	10.4	10.4	2.7	1.5
English............	9,115	29.2	16.5	11.8	10	10.7	8.9	8.8	2.5	1.9
French.............	941	29.1	18.5	10.1	10.8	9.8	10.8	5.9	4.1	2.7
German............	4,378	28	17.5	12.7	9.6	9.9	7.4	10.9	3	1.6
Greek..............	284	23.8	24.9	13.9	8.9	8.2	13.5	5.3	2.1	0.4
Hebrew............	1,315	17.2	25.2	14.9	7.5	15.4	7.1	5.6	0.5	6.7
Irish...............	4,505	21	14.8	11.8	11.6	11.1	8.2	6.4	11.2	5
Italian.............	2,456	32.7	18.1	9.7	7.8	9.3	12.9	3.8	0.6	5.3
Mexican...........	384	66.9	4.2	4.7	5.7	3.9	11.7	3.4	0	0.5
Mixed..............	23,724	27.5	18.4	12.2	10.2	9.9	8.7	7.2	2.8	3.7
Scandinavian......	1,261	23.6	17.5	17.3	10.1	8.4	6.8	10.5	4.3	1.9
Scotch.............	580	12.4	18.3	12.3	16.6	10.7	9.3	10.4	5.5	4.7
Slavonic...........	2,488	37	15.3	14.4	7.3	10	6.6	5.7	3.1	1.2

The correlation of mental deficiency with other neuropsychiatric conditions gives important information, both as to mental deficiency in relation to the United States average for white persons and in relation to its average distribution among the negroes exclusively.

Of the first, Table 6 shows that, with the exception of mental deficiency and epilepsy, the negro falls below the United States average for all neuropsychiatric conditions. The negro falls much farther below both white and negro average for all these conditions in seven states in which he exceeds the negro United States rate for mental defectives. An undue distribution of mental defect inevitably necessitates a falling off in other neuropsychiatric conditions; but, as stated before, when mental defect is above the average, the falling off affects especially mental diseases, constitutional psychopathic states and inebriety.

The Provost Marshal-General in his final report credits the negro draftee with a somewhat better physique than the white. The present statistics bear this out as far as the two neuropsychiatric conditions which have a definite physical basis are concerned, namely, neurologic conditions and endocrine disturbances. The particular distribution of neuropsychiatric defects among negroes points them out clearly as a primitive race. Physically, they may be above the average of the people with whom they associate, but they are far below that average in mental capacity.

It will hardly be possible to determine what better social opportunities and education will do for negroes before the present high incidence of mental defect among them is reduced.

American Indian.—(Number classified, 124.) The American Indian, or Amerindian, as H. G. Wells calls him, is primitive like the negro, and exceeds even him in mental deficiency. He is not as much below the United States average in alcoholism or drugs as the negro, and is somewhat below the negro in epilepsy, as indeed he is below the United States average in that disease. In other conditions, namely, neurologic, psychoses, psychoneuroses, endocrine and constitutional psychopathic states, he is far below the United States average. His high mental deficiency percentage leaves little room for anything else. The small number of American Indians classified should be borne in mind when these statistics are considered.

Dutch.—(Number classified, 331.) The Dutch are close to the United States average in all groups. The indications are that they ingest more alcohol than drugs, but in both they fall below the United States averages. They have a few less neuroses and a few more of the other classified disorders.

English.—(Number classified, 9,115.) The English, like the Dutch, approximate the United States average in all groups. They appear more inclined to drink than to take drugs, and to have a slight excess of epilepsy, endocrine troubles and constitutional psychopathic states. They just reach the United States average for mental defect.

French.—(Number classified, 941.) The French show rather a high distribution of inebriety, being considerably above the average in alcoholism, and only a little below it in drug addiction, their total percentage of inebriety distribution being 6.8 per cent. as compared with 4.4 per cent. for the English, and 4.6 per cent. for the Germans. They also exceed the average in the number of cases of psychoneuroses, neurologic conditions, epilepsy—and by 0.1 per cent. constitutional psychopathic states. They are considerably below the average in endocrine disease and are at the United States average for mental defect. The excess of inebriety in the French may surprise many as the French are said to be a wine-drinking people, and it is a common belief wine-drinking people do not suffer from alcoholism. As a matter of fact, alcoholism depends on the actual amount of alcohol imbibed, rather than on the form in which it is taken. If enough wine or beer or any other beverage with comparatively low alcohol content is taken, a person becomes alcoholic. As far as France is concerned, large quantities of spirits are consumed in that country in addition to wines, and it may be that this custom persists among the French who live in this country.

The Native-Born German.—(Number classified, 4,378.) In spite of his reputed beer-drinking custom, the native-born German, according to the statistics, fails to reach the United States average in alcoholism and is not much given to drugs. On the other hand, he exceeds slightly the United States average in psychoses, neuroses and constitutional psychopathic states, and in endocrine diseases by 3.5 per cent. He is slightly below the United States average in mental defect.

The Foreign-Born German.—(Number classified, 188.) The foreign-born German shows a much higher rate for insanity than the native-born, and a considerably higher rate in endocrine diseases. Mental defect, on the other hand, is considerably less.

Greeks.—(Number classified, 284.) The Greeks are very low in inebriety, especially as concerns drugs, but exceed the United States average in epilepsy, psychoses and psychoneuroses, an excess particularly noticeable in epilepsy and psychoneuroses. They are well below the average in mental defect and constitutional psychopathic states.

Jews.—(Number classified, 1,315.) The American Jew shows a striking contrast in his habits of inebriety as far as the choice of alcohol and drugs is concerned. The number of Hebrew alcoholic patients is almost negligible, while the percentage of drug addicts is more than double the United States rate. The percentage of neurologic conditions, epilepsy, endocrine diseases and mental deficiency among Jews is also low. The low percentage of mental defect is particularly striking, the only classified races which show less being the Scotch and the Welch. The Jew exceeds, on the other hand, the average representation in the conditions characterized by emotional instability. The percentage of insanity among Jews is nearly 2 per cent. above the United States average and is very much above it for psychoneuroses and the constitutional psychopathic states.

Native-Born Irish.—(Number classified, 4,505.) The native-born Irish show the most pronounced tendency to inebriety of any neuropsychiatric group, and their intemperance relates to both alcohol and drugs. Inebriety constitutes 16.2 per cent. of all their neuropsychiatric disorders. Approximately one sixteenth of all the neuropsychiatric cases being found among the native-born Irish, more than one fifth of all patients with alcoholism were identified as native-born Irish by the neuropsychiatric examiners and more than one sixth of all patients with drug addiction. With the exception of inebriety, epilepsy and constitutional psychopathic states, they sink below all United States averages. They are so far below this average in mental defect that they confirm the general law of the incompatibility of alcoholism and mental defect. They also furnish an interesting example of a high distribution of alcoholism with an under average of mental disease. It would seem that if alcoholism were an important cause of insanity, one would find an excess of insanity instead of an under average in a people so given to alcoholic intemperance as these people are. But in this connection it should be remembered that drafted men were too young to develop alcoholic insanity and also that alcoholic insanity among the Irish is more common in women than in men.

The Irish offer an interesting comparison with the native-born English. There are 11.8 per cent. more cases of inebriety among the Irish and 8.2 per cent. less cases of mental defect. The excess of alcoholism and the lesser amount of mental defect would indicate that they are a livelier, more excitable race than the English, which is borne out by their having a slight excess of constitutional psychopaths as compared with the English.

Foreign-Born Irish.—(Number classified, 413.) The difference between the native-born and foreign-born Irish in regard to nervous and mental diseases is that among those born in this country the distribution rate of mental defect is nearly 7 per cent. more than among the foreign-born, and among them also there is a higher distribution rate of constitutional psychopathic states and of endocrine disturbances. The average for insanity and inebriety, however, is lower. These are nearly 8 per cent. less in the distribution of mental disease among those born here. Inebriety changes both in extent and in its own distribution. There is a lessened total of inebriety of 6.4 per cent. among the native-born, and even a greater falling off in the distribution rate of alcoholism. Nearly one half of the decrease in alcoholism is accounted for by an increase in drug addiction among the native-born. It would seem at first sight that this lowering of the distribution rate for insanity is to be connected with the lowering of the rate of alcoholism, but it should be observed that a similar decrease in the distribution of insanity occurs in the Germans with a very minor decrease in alcoholism, and a smaller decrease in insanity among Scandinavians with a larger decrease in the rate of alcoholism.

Also, as far as the Irish are concerned, the material increase in mental defect and in constitutional psychopathic states should be noted.

Native-Born Italians.—(Number classified, 2,456.) The native-born Italians present a distribution of neuropsychiatric disorders which indicate a sluggish, backward mentality. As drug addicts they rank next to the Jews, and, like the Jews, are little given to alcoholic inebriety. Some races, such as the Jewish and the Irish, seem to be able to surpass the average in drug inebriety, and still, through the low percentage of other disorders which indicate racial backwardness, retain the characteristics of nimble-minded people. For example, the Irish, while they are excessive drug users, are more given to intemperance in alcohol than in drugs; and of the two, alcoholic intemperance is indicative of more active mentality than is the secret and solitary use of drugs. Both the Irish and Jews, while exceeding the average in the use of drugs, are far below it in mental defect. But the Italians make the poorer choice for the satisfaction of their inebriate tendencies, and in addition to that, show their racial backwardness by a preponderance of those other disorders which must be accepted as indicative of inferiority. In mental defect the native-born Italians exceed the United States average by 3.5 per cent., and in epilepsy they exceed the United States average by 4.3 per cent. In respect to the distribution of neuropsychiatric defect in general, they manifest a remarkable correlation with the two primitive races, the African and the Amerindians. All three have an excess of mental deficiency and are below the average in those disorders which indicate a developed mentality, namely, mental diseases and constitutional psychopathies. All are low in endocrine disturbances. Both the negroes and the Amerindians use drugs more than alcohol, and the negroes, like the Italians, have an excess of cases of epilepsy.

Foreign-Born Italians.—The foreign-born Italian shows so little variation from the native-born in the distribution of neuropsychiatric disorders that it seems that being brought up in this country has little effect on him in that respect. The rate for epilepsy is somewhat higher among the foreign-born, but, with the single exception of drug taking, the Italian who comes here is not much better and not much worse off than the one born here. Drug addiction is substantially more frequent among the native-born, as in fact it is among all the native-born foreign races except the German.

Mexicans.—(Number classified, 384.) Of all races classified, the Mexican stands first in mental defect, the rate being 66.9 per cent.

It exceeds that of the Africans and Amerindians. With the single exception of epilepsy, they are below the United States average in every other neuropsychiatric group. They seem to be swamped in their own dulness, and they cannot develop, to any great extent, any of the disorders which indicate an active or emotional intelligence. There was not a single alcoholic person among those examined and only two drug addicts, as contrasted with forty-five epileptic patients and 257 mentally defective. One would hardly expect that a race so slothful as the enormous amount of mental defect found among them make the Mexicans appear to be, would be a drinking people. But it is rather surprising that they are so free from drug addiction. Mexico is said to be one of the points from which opium (and its derivatives) is smuggled into this country, and one would naturally think that the Mexicans themselves would become addicted to the use of it.

The Mixed Race.—(Number classified, 27,724.) The mixed races include those whose ancestors were of different races. This group, of course, includes many "Americans." The large number in it (one third of the total number of cases) makes this group fundamentally important in the establishment of the United States average.

Scandinavians.—(Number classified, 1,261.) Native-born Scandinavians (Norwegians, Danes, Swedes, Icelanders) show an excess of inebriety—alcohol inebriety preponderating—mental and endocrine disturbances. They exceed, but by a small fraction only, the United States average of neurologic disorders and neuroses. They are well below the average in mental defect and, almost as a corollary of this, in epilepsy.

Foreign-Born Scandinavians.—(Number classified, 454.) The foreign-born Scandinavians show much less mental deficiency than those born here, and, strangely enough, less endocrine disturbance. On the other hand, they show an excess distribution of alcoholism and insanity as compared with the native-born.

The Scotch.—(Number classified, 580.) The Scotch exceed the United States average in all groups except that of mental deficiency. The mental deficiency rate, 16.8 per cent., is lower than that of any race, being below the United States average. This bears out the reputation of the Scotch for intellectual superiority. The inebriety is high, but as in all races which have a low mental deficiency rate, alcoholism exceeds drug taking.

The Slavs.—(Bohemians, Bosnians, Croatians, Dalmatians, Herzegovinians, Montenegrins, Moravians, Poles, Russians, Ruthenians, Serbians, Slovaks and Slovenians. Number classified, 2,488.) The Slavs have a high mental deficiency rate in spite of which their inebriety is alcoholic rather than narcotic, although both varieties are below the United States average. The comparative infrequency of epilepsy is worthy of remark, especially in view of the high rate of mental deficiency. In spite also of the sluggishness indicated by the excess of mental deficiency, they have an emotional sphere of some activity, as is shown by the excess of psychoses among them.

INVOLVEMENT OF THE PERIPHERAL NEURONS IN DIABETES MELLITUS *

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Introduction
Reports of Pathologic Conditions in the Literature
Clinical Reports in the Literature
  (*a*) Polyneuritis
  (*b*) Mononeuritis
  (*c*) Motor Type
  (*d*) Sensory Type
  (*e*) Cranial Palsies
Statistics of Personal Observations
Explanation of the Site of Involvement
Conclusions

INTRODUCTION

The object of this paper is to review critically the state of our knowledge of the site of involvement of the peripheral neurons in diabetes mellitus; to this will be added some data and opinions from my own experience with particular reference to the question of neuritis.

REPORTS OF PATHOLOGIC CONDITIONS IN THE LITERATURE

The pathologic reports are scanty and unsatisfactory. They may be roughly divided into those which place the lesion in the spinal cord and those which place it in the peripheral nerves. The last review is by Schweiger,[1] who discussed especially changes occurring in the intramedullary sensory roots and posterior columns. Schweiger gathered the case reports of sensory tract and root disease up to 1909.

Because of complicating syphilis and tuberculosis all of these cases, with the exception of two, that of Souques and Marinesco[2] and Schweiger's second case[1] must be discarded. There is no case report for the former, and in the latter all that is said as to examination is "patellar reflexes present, sensation of the legs diminished. The patient died in coma." This evidence is not very convincing. Findlay[3] reported pathologic findings after Schweiger, but his patient was also tuberculous with a positive sputum, therefore his case cannot be accepted, for tuberculosis may also cause posterior column degeneration.

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* Read at the Forty-Seventh Annual Meeting of the American Neurological Association, Atlantic City, N. J., June, 1921.

[1] Schweiger, Ludwig: Ueber die tabiformen Veränderungen der Hinterstrange beim Diabetes, Arbeiten aus dem Neurologische Institut der Wiener Universität **14**:391, 1908.

[2] Souques and Marinesco: Lesions de la moelle epinière dans un cas de diabète sucré, Rev. Neurol. **5**:654, 1897.

[3] Findlay: Changes in the Peripheral Nerves in a Case of Diabetes Mellitus, Glasgow M. J. 1907, p. 256.

Reports of anterior horn cell degeneration are also found, but none except Marinesco's case in 1901[4] is free from complications. This case therefore yields no reliable evidence of primary peripheral neuritis.

Changes in the peripheral nerves have been reported, but of these cases few are free from such complications as infected gangrene, tuberculosis and syphilis. None is reported after the introduction of the Wassermann test.

Summary.—1. We have no reliable pathologic evidence except the reports of Souques and Marinesco, of Schweiger and of Marinesco. The clinical findings here are too meager to make these reports of value.

2. There is no pathologic evidence of primary peripheral neuritis.

CLINICAL REPORTS IN THE LITERATURE

The clinical reports are roughly divisible into those describing mononeuritis or polyneuritis, and those describing chronic anterior poliomyelitis. It is noteworthy that, with few exceptions, the findings indicate that the peripheral neurons are affected either in their sensory or motor parts. The cases of so-called mononeuritis are either exclusively sensory or show atrophy or paresis.

(*a*) *Polyneuritis.*—In the group of about twenty cases reported as polyneuritis it is remarkable that, with only one exception, the clinical picture is either sensory, objective and subjective, or motor with no objective sensory changes. In both groups pain or neuralgia was present. Buzzard's[5] case alone showed involvement of both sensory and motor fibers. With this exception the reported cases suggest disease either of the motor cells and roots or of the sensory roots. They do not indicate involvement beyond the junction of the motor and sensory roots, that is, peripheral neuritis.

The cases of Pitres and Marchand (1917)[6] Reich,[7] Nonne[8] and Charcot[9] showed motor involvement, the only sensory disorder being neuralgia. Rimbaud's case,[10] on the other hand, was sensory only, showing disturbance of all forms of sensation. The cases of Packard,[11] Pryce,[12] Unschuld[13] and Findlay[3] were complicated so as to make conclusions uncertain. Buzzard's[5] case was the only one of typical sensorimotor neuritis. Williamson,[14] who has seen many cases of diabetes, states that sensorimotor neuritis is either very rare or that it does not exist at all. My own conclusions are that cases showing with parallel intensity, and in the same nerve distribution, both paralysis and atrophy and changes in deep and superficial sensation do not occur as a result of diabetes. In other words, true sensorimotor neuritis does not occur.

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[4] Marinesco, G.: A Case of Diabetic Paraplegia. Read at a meeting of the Neurological Society of Paris, July 4, 1901; Abstr., Neurol. Centralbl., 1901, p. 94.

[5] Buzzard: Illustrations of Some Less Known Forms of Peripheral Neuritis, Especially Alcoholic Monoplegia and Diabetic Neuritis, Brit. M. J., 1890, p. 1422.

[6] Pitres and Marchand: Des polynevrites diabétiques, Progres méd. **36**: 295-297 (Sept. 8) 1917; abstr., J. A. M. A. **69**:1834 (Nov. 24) 1917; abstr., Rev. Neurol. **23**:141, 1918.

[7] Reich, A.: A Case of Diabetic Multiple Peripheral Neuritis, Med. Rec. **45**:59 (Jan. 13) 1894.

[8] Nonne: Ueber Poliomyelitis bei Diabetes Mellitus, Berl. klin. Wchnschr. 1896, No. 10, March 9.

[9] Charcot, M.: Sur un cas de paraplégie diabétique, Arch. de Neurol. **19**:318 (May) 1890.

However, there seem to be two groups of cases which, at first sight, simulate polyneuritis: one due to disease of the anterior horn cells or the intramedullary portion of the lower motor neurons and associated with neuralgia, the other due to involvement of the intramedullary sensory tract, as in some forms of tabes. The following case from the service of Dr. Foster Kennedy at Bellevue Hospital is an example of the combination of these.

CASE REPORT

The chief complaint of Mrs. A. L., admitted to Bellevue Hospital Oct. 2, 1920, was inability to walk. Her family and past histories were negative; alcohol had not been used and there was no syphilis. Two weeks ago the patient was unable to walk on account of pain and stiffness about the ankles. There was no swelling of the joints.

Physical Examination.—The patient did not look ill. The general medical examination was negative. The pupils reacted fairly well to light and in accommodation. The deep reflexes were normal in the upper extremities, absent in the lower. There was no Babinski sign and no ankle clonus. No sensory disorders were noted. On October 5, the patient could not walk as her legs doubled up under her. On the right there was paralysis of the iliopsoas and tibialis anticus. There was complete paralysis of the quadriceps. The patient was

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[10] Rimbaud, L.: Névrite diabétique, Gaz. d. hôp. **82**:1555 (Nov. 2) 1909; abstr., Rev. Neurol. **20**:502, 1910; abstr., Neurol. Centralbl. 1910, p. 936.

[11] Packard, F. H.: A Case of Neuritis in the Course of Diabetes, Boston M. J., 1902, p. 324.

[12] Pryce, T. D.: A Case of Perforated Ulcers of Both Feet Associated with Diabetic and Ataxic Symptoms, Lancet **2**:11 (July 2) 1887; 1888, p. 59. On Diabetic Neuritis with a Clinical and Pathological Description of Three Cases of Diabetic Pseudo-tabes, Brain **16**:416, 1893; abstr., Rev. Neurol. **2**:122. 1894.

[13] Unschuld: Ueber ein bisher nicht gewürdigtes Symptom des Diabetes Mellitus, Berl. klin. Wchnschr. **28**:649, 1894.

[14] Williamson, R. T.: Diabetes and Its Treatment, Edinburgh, 1898; The Nervous Complications of Diabetes Which Are Associated With Changes in the Peripheral Nerves and Spinal Cord, Rev. de méd. **31**:872, 1911; abstr., Rev. Neurol. **24**:304, 1912; Diseases of the Spinal Cord, London, 1911.

unable to hold up her legs. Knee and Achilles reflexes were absent. The arms were normal. On October 8, the upper extremities were normal. The abdominal reflexes were absent (lax abdominal wall). She complained of pains in the legs. The blood Wassermann reaction was negative. On October 15, urinalysis revealed sugar, 4 per cent., 36.4 gm. On October 18, there were 256 mg. of blood sugar. On November 2, patchy analgesia and tactile anesthesia were present over the feet and legs, which was neither clearly neural nor segmental in distribution. Position sense in the great toes was normal. On November 28, electric tests of muscles were made. Condenser current (normal response, 0.01 to 0.05 microfarads):

	Right	Left
Tensor fasciae latae	0.39	0.09
Quadriceps femoris	No contraction	No contraction
Adductor longus	1.99	0.49
Vasti	?	1.00
Sciatic nerve	0.29	0.19
Tibial nerve	0.09	0.09
Peroneal nerve	No response	0.09

On January 6 sensory changes were less and of no definite distribution. Muscle sense was normal in the toes. The patient was discharged, unimproved. On June 1 the patient was visited at her home. She had been in bed and had not walked since leaving the hospital. She had been on an ordinary diet. Her cutaneous and muscle sensations were normal. The legs were flexed at the hip and knee. There was contracture of the hamstrings. Flexion of the thigh by the iliopsoas was poorly executed. No extension at the knee was possible. There was marked atrophy of the quadriceps femoris. Movements of the toes and at the ankle were present. The knee and Achilles jerks were absent. There was no Babinski sign. In brief, motor paralysis with atrophy of the quadriceps and weakness of the muscles supplied by the femoral and external popliteal nerves, was present.

Impression.—The condition appeared to be chronic anterior poliomyelitis. The neuralgic pains and sensory changes, irregular at first and absent at the last examination, suggested a transient intramedullary sensory radiculitis.

(*b*) *Mononeuritis.*—There are also reports of isolated paralysis (mononeuritis), though these are not numerous. The sciatic cases were, with one exception, all reported in pre-Wassermann days and on that score alone are not entirely trustworthy. The most important group of paralyses are those of the muscles supplied by the crural and obturator nerves. In 1913, Byrnes[15] could find only ten or eleven cases of "crural neuritis." A number of these are reported as "polyneuritis." In the case reports which I have found there have been recorded no objective sensory changes, only neuralgic pains were present. Bruns,[16] reviewing the matter in 1907, stated that the obturator and crural nerves were especially involved in diabetes. But with objective sensory changes lacking, involvement of the peripheral parts of the neurons cannot be assumed.

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[15] Byrnes, Charles Metcalfe: Anterior Crural Neuritis, J. Nerv. & Ment. Dis. **40**:758-778, 1913; **41**:19-31, 1914.

[16] Bruns, L.: Ueber Neuritis Diabetica und Alcoholica, Deutsch. Ztschr. f. Nervenheilk. **36**:17, 1908; abstr., Neurol. Centralbl. **27**:1000, 1908.

(*c*) *Motor Type.*—The cases belong rather in the motor group noted in the foregoing than in a group of peripheral neuritides. The motor cases not of "mononeuritic" distribution described as "polyneuritis" also showed a predominance of involvement of the muscles supplied by the crural nerves, as illustrated in the foregoing case report. This leads to the belief that the cases called obturator and crural neuritis are mild forms of a more widely spread paralysis of the legs, incorrectly called "polyneuritis." The earliest manifestation of this condition is "giving way of the legs" owing to slight weakness of the flexors of the thigh and the extensors of the knee. When this becomes aggravated the picture resembles that of neuritis. Indeed, a proximal form of paralysis of the lower extremities does not seem to be an uncommon manifestation of diabetes mellitus and presents the clinical picture of spinal cord involvement and chronic anterior poliomyelitis rather than of polyneuritis. Such proximal involvement resembling polyneuritis results from other causes and is of central origin.

(*d*) *Sensory Type.*—Sensory disorders of diabetes may be divided into a number of types, each of which represents a greater involvement than its predecessors: first, increased reflexes, then diminished or absent reflexes due to involvement of the afferent part of the arc. A further stage consists of diminution or absence of the sensation of touch. Pain and the temperature are rarely affected. Finally, deep sensation may be involved, producing pseudotabes. To any of these neuralgia may be added.

The cases of pseudotabes prior to 1906, the beginning of the Wassermann era, are better discarded since there is always some doubt as to the presence of an old undetected syphilitic infection. Subsequent to that date very little is to be found. Van Noorden,[17] in 1910, said that he had seen only three cases which could be designated pseudotabes. One was alcoholic. He grouped these cases under the general heading of polyneuritis. Hartmann and Schrottenbach,[18] in 1912, make no reference to cases subsequent to 1906. They sum up by saying, "The question whether this form of disease be a true peripheral condition is more than doubtful in view of the investigations of Schweiger."

The problem is not an easy one to solve at the present time. That such a condition could arise from intramedullary root degeneration is

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17. Van Noorden, Carl: Die Zuckerkrankheit und Ihre Behandlung, Berlin, 1910.

18. Hartmann, Fritz, and Schrottenbach, Heinz: Die Endogen Vergiftungen des Nervensystems, in Lewandowsky: Handbuch der Neurol. **3**:1106, 1912.

obvious. Whether it really does remains to be decided. Cases which would come under this heading must be, at least, quite free of any evidence of syphilis. The cases described showed a strictly sensory syndrome. They therefore correspond to the notion that the lesion is located in the intramedullary sensory root, whether syphilitic or diabetic or both.

(*e*) *Cranial Palsies.*—With the exception of paralysis of the third, fourth, sixth and seventh cranial nerves, paralyses of the cranial nerves are rare, many of them complicated in such a way as to be open to doubt. Such cases as do occur are uncommon. Paralysis of the eye-muscles is of the peripheral type. Paralysis of the facial nerve, of which I have seen three examples, is also peripheral in type. This agrees with the notion of peripheral neuron involvement.

STATISTICS OF PERSONAL RESEARCH

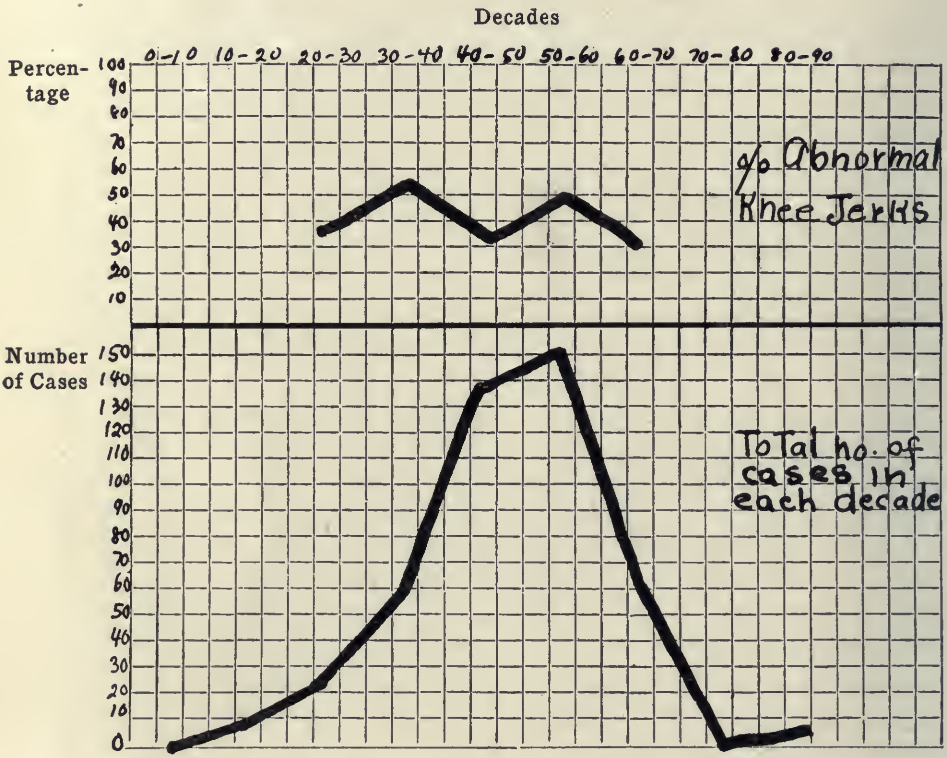
The frequency of involvement of the intramedullary sensory root may be judged by the fact that of about 450 case records examined at the Vanderbilt Clinic 40 per cent. showed abnormal knee reflexes (Fig. 1). Many of these had associated neuralgias or paresthesias. This corresponds to the findings of other observers. The abnormal reflexes are, in the vast majority of cases, either the knee or Achilles reflexes. The lumbosacral segments are usually those affected. This corresponds with Bruns' idea that diabetes mellitus usually affects the muscles supplied by the obturator and crural nerves, and with the distribution of the motor forms of paralysis already described. The upper extremities are relatively immune, though atrophies and reflex changes are occasionally found. In contrast to 40 per cent. of nearly 450 cases with abnormal knee jerks, I have found only one case showing muscular atrophy. It would therefore seem that diabetes mellitus commonly produces a strictly sensory disorder, and rarely a motor disorder.

EXPLANATION OF THE SITE OF INVOLVEMENT

What is the reason for the intramedullary involvement which the clinical pictures suggest? The neurilemma sheath stops at the pia. A lesion of the non-neurilemmatized portion of the peripheral neurons within the spinal cord will amply account for the clinical pictures. Such a selective action occurs under certain circumstances in other diseases such as diphtheria, tetanus and syphilis.

CONCLUSIONS

For the present we must rely on the clinical picture. Analysis of the records of others and my own experience in the clinic indicate involvement of the motor cells and roots or of the intramedullary portions of the sensory roots and their continuance within the spinal cord. Its analogues, the midbrain, pons and medulla, may be similarly affected. Both motor and sensory involvement may occur at the same time. Satisfactory clinical evidence of primary extramedullary involvement of the peripheral neurons, that is, peripheral neuritis, has not been obtained, either from a review of the clinical and pathologic reports in the literature or from my own experience.



Results of testing knee jerks in cases of diabetes mellitus.

DISCUSSION

Dr. Hugh T. Patrick, of Chicago, called attention to these facts: First, in systemic poisoning affecting the peripheral nerves, it is well known that ordinarily the motor neuron is much more vulnerable than the sensory; second, diabetic patients are especially susceptible to general infections, the ordinary everyday infections. Dr. Patrick believed that in many of the cases in which the patients had painful legs the pain was not due to diabetes but to some infection. In other words, the pains belonged in the broad category of rheumatism.

Dr. Walter M. Kraus, of New York, in answer to Dr. Patrick, regarding the occurrence of pain, said that the time was so short it was impossible to go into detail, but he felt that one should be cautious in certain directions which Dr. Patrick had suggested, and also in other directions, namely, in the assumption that the pain was always peripherally produced. He said that it had been abundantly shown that pain might be centrally produced, and if it could be shown in the future that there was an involvement of the intramedullary portion of the root in diabetes, there was no reason why the pains and paresthesias could not be shown to be due to this involvement of the intramedullary portion of the root. The fact that these pains came and went with treatment indicated that that hypothesis might hold in the future.

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EQUILIBRATION AND THE VESTIBULAR APPARATUS *

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Rules for testing the vestibular apparatus have been formulated by Bárány, Jones [1] and others, and they have also indicated certain (suppositious) intracranial paths for the vestibular nerve. Furthermore, following the suggestion of Dana and of Mills, Jones has assumed a cerebral center for this nerve. Following these and other writers, principally otologists, the tests are being applied by large numbers of men who, because of inadequate neurologic training, are incompetent to interpret the findings. Consequently, in the crucial matter of diagnosis they are leading themselves and others astray.

Therefore I purpose briefly to discuss: (1) the possible existence of a center of equilibration and its location, (2) the intracranial pathways related to the semicircular canals, and (3) the clinical value of the vestibular tests.

EQUILIBRATORY CENTER AND ITS LOCATION

The first to mention cortical centers for the vestibular nerve was Dana,[2] who in 1889 reported two cases with necropsy. In these the lesions were located in the right temporal convolution. Briefly the cases were as follows:

> The first, a woman 32 years of age, received a blow on the head and eighteen months later had chills, fever and temporary rigidity of the left arm, and four months later vertigo with forced movements, falling suddenly, always backward and to the right. The duration of the symptoms was two years. At necropsy there was found softening of the right third and fourth temporal convolutions in the middle three-fourths. Microscopic sections of the limiting walls showed decided inflammatory change, there being a thin pyogenic membrane evidently in the process of forming. The point of the lesion lay directly over the upper surface of the petrous bone and at this point the meninges were thickened and adherent. No mention is made of microscopic lesions elsewhere with the exception that an examination of the cerebellar peduncle did not show degeneration to the naked eye.

The second patient was brought to the hospital in an "active" stage of delirium tremens and died within twenty-four hours. A history

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* Read at the Forty-Seventh Annual Meeting of the American Neurological Association, Atlantic City, N. J., June, 1921.

[1] Jones, I. H.: Equilibration and Vertigo, Philadelphia, J. B. Lippincott Co., 1918.

[2] Dana, Charles L.: J. Nerv. & Ment. Dis. **14**:412 (July) 1889.

was obtained from friends who said that he had had dizziness. Necropsy showed chronic meningo-encephalitis in the right temporal lobe. In this paper Dana said that he had been unable to find similar cases in the literature and thought there might be some evidence that the vestibular center was in this location.

Obviously neither of these cases would be accepted by Dr. Dana today as evidence of such a center. In the first case the forced movements were probably the result of implication of the striate body. No mention is made of a study of the cerebellum.

The second patient died within twenty-four hours of his admission to the hospital, and the history of vertigo was obtained from friends.

Mills[3] assumes the presence of a cortical center for the vestibular nerve in the second convolution of the temporal lobe. He cites a case of a tumor in the midtemporal region in which the left third and fourth convolutions and the subjacent medullary substance were involved. The first symptom of which the patient complained was vertigo, which was present for five years previous to death. This was a recurring phenomenon. She had neither ataxic nor forced movements, but there were certain aphasic symptoms and as a consequence of these, Dr. Mills postulated a naming center.

I have been unable to find any other pathologic evidence of an equilibratory center in the temporal lobes.

The basis for the theory of a cortical vestibular center is the assumption that as there is a cortical center for hearing in the temporal lobe, there must also be a vestibular center.

Most writers who discuss the presence of a cortical vestibular center assume that this means an equilibratory center, making no distinction between the motor disturbances resulting from cerebellar and vestibular lesions. Ordinarily, by equilibration is meant that function by means of which posture is maintained and movements properly synergized. There may be disturbance of equilibrium through sensory lesions, as in tabes, or as a result of labyrinthine disease. It is apparent that the normal performance of a complicated movement such as walking, which is one of the highest expressions of equilibration, requires the harmonious action of a number of sensory impulses, such as the visual, common sensory and kinesthetic, vestibular and auditory. There is no doubt that the coordination of these sensory impulses occurs in the cerebellum, for this organ is directly connected with the frontal, parietal, temporal and occipital convolutions, as well as with the vestibular apparatus. Equilibration therefore is the normal function of the cerebellum and as such needs no cerebral representation.

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[3] Mills, Charles K.: Nervous System and Diseases, Philadelphia, J. B. Lippincott Co., 1918.

At this point it seems necessary to define the function of the semicircular canals, for if they have a distinct function, they should have cerebral representation as have the other special senses and ordinary sensation.

In all probability the vestibular mechanism plays the leading rôle in equilibration. In fact, from the standpoint of development, the cerebellum may be regarded as a highly specialized vestibular nucleus. Many experiments have been performed as to the relative function of the vestibular nerve and cerebellum. Perhaps the aviator has best shown the function of the semicircular canals. In the experiments at Mineola during the war it was found that deaf-mutes who lacked vestibular function, when taken up blindfolded, could not recognize simple airplane evolutions, nor develop any proficiency in sensing motion. These tests were checked by identical maneuvers with normal persons, who on their first trial were able to detect the maneuvers much better than the deaf-mutes, and with few repetitions, quickly increased this ability.

This shows rather conclusively that the duty of the semicircular canals, the saccule and utricle, is to inform the individual through his cerebrum of the position of the body in space, as regards both motion and posture.

Frequently it has been stated that fliers have found themselves upside down without knowing it and that sometimes they have been able to fly without sight, hearing and common sensibility. But experienced aviators tell me that it would be impossible for a flier to be upside down without his knowledge, and as to ability to fly without sight, feeling or hearing, while this may be true for a brief time, the best flier is the one who is fully normal.

Though analogy would indicate cerebral representation of the vestibular function, so far as is known there is no direct connection between the vestibular nucleii in the brain stem and the cerebrum. The vestibular fibers which go to the cerebellum do not go directly to the dentate nuclei. Anatomically it has been shown that fibers go from the dentate nuclei by way of the superior cerebellar peduncle to the thalamus. Their further course has not been traced, but it has been assumed that they go somewhere to the cortex to form the center for vestibular function. Assuming that there is a cerebral center for vestibular function, there is no anatomic evidence that such a center should be in the temporal lobe, for the fibers for hearing and vestibulation take an entirely different course after their entrance into the brain stem. If such a center exists, it is probably located with the other great sensory centers, in the post central and parietal lobules.

INTRAMEDULLARY COURSE OF THE VESTIBULAR FIBERS

As the result of clinical experience alone, Jones and Fisher[4] suggested that the intramedullary fibers from the vertical and horizontal canals had a separate pathway, the fibers from the horizontal canal entering the cerebellum through the inferior cerebellar peduncle, while those from the vertical canals enter by way of the middle cerebellar peduncle. In the cases published by Jones and Mills,[5] there was some pathologic evidence to support this contention, but serial microscopic sections were not made. There is no doubt that in lesions of the posterior cranial fossa a common finding is the absence of response from stimulation of the vertical canals with normal response from the horizontal canal. There is therefore some ground for the belief that the fibers from the vertical and horizontal canals have separate pathways, but there is no need to assume that they enter the cerebellum—one by the inferior and the other by the middle cerebellar peduncle. In all probability the fibers from the vertical and horizontal canals have a separate pathway within the eighth nerve and also have separate nuclei in the medulla. Probably both enter the cerebellum by the inferior cerebellar peduncle.

THE VALUE OF VESTIBULAR TESTS

The value of these tests depends largely on the accuracy of our knowledge of the course of the vestibular fibers after their entrance into the brain-stem. As the course of the vestibular fibers is not accurately known, it would seem that any diagnosis based solely on the presence or absence of the reactions from stimulation of the vestibular tracts would be inaccurate. Experience, however, has shown that in lesions, especially of the posterior cranial fossa, similar findings are nearly always obtained, and therefore a few clinical deductions are permissible.

Perhaps because of the war, otologists have learned to apply the Bárány tests, but few neurologists have practical knowledge of the tests or of their application in neurologic diagnosis. Consequently, otologists have been led to furnish diagnoses of intracranial lesions, obviously exercising a function outside of their sphere. Clearly these tests should be performed by neurologists with otologic training or otologists with neurologic training.

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[4] Jones, Isaac H., and Fisher, Lewis: The Technic of Examination of the Static Labyrinth, Ann. Otol., Rhinol. & Laryngol. **26**:1 (March) 1917.

[5] Mills, Charles K., and Jones, Isaac H.: Tests by Bárány Methods Demonstrating Neuraxial Differentiation of the Fibers from the Horizontal and the Fibers from the Vertical Semicircular Canals, J. A. M. A. **67**: (Oct. 21) 1916.

Without going into details, I venture to point out certain conclusions regarding the tests which have been so frequently reached that they may be considered obvious:

1. The value of ear tests in pure labyrinthine disease as distinguished from cerebellar disease is beyond question.

2. It is impossible to distinguish between lesions of the eighth nerve itself and the labyrinth.

3. Lesions in the posterior cranial fossa which either compress or invade the brain-stem, may cause modification of the normal ear responses. Usually there is absence of, or diminution of, responses to stimulation of the vertical canals, with good or perverted responses from the horizontal canal. Perhaps the most definite finding so far is in tumors of the cerebello-pontile angle, growing from the eighth nerve. These are: total absence of all response from the eighth nerve of the affected side with no response of the vertical canals from the opposite side, leaving the horizontal canal on the opposite side the only functioning one.

4. In lesions of the cerebellum there is nearly always absence or marked diminution of vertigo on stimulation.

5. In differentiating between supratentorial and infratentorial lesions, the presence of normal responses from both labyrinths strongly indicates a supratentorial lesion.

These conclusions serve to indicate the value of ear tests in intracranial work. That the results of the tests are not uniform every neurologist would surmise, but that the ear findings should be considered is obvious.

Results similar to those in posterior fossa lesions have been obtained in other conditions, for example, toxic states and hysteria. It is of course very well known that ordinarily vertigo is the result of functional disturbance of the vestibular apparatus; that is, the neurologist finds no organic nervous disease. In a patient with vertigo examined by Dr. Jones, the ear tests indicated a lesion of the cerebellum, but the patient had a typical traumatic neurosis. She was suing a transit company and after settlement of the case the vertigo promptly disappeared. In another instance a competent otologist referred his wife for examination, because of dizziness. The ear tests showed some disturbance of the vestibular apparatus. I examined this patient and found no organic symptoms, and after reassurance on my part that the symptoms would disappear, she rapidly became well.

It is well known that some toxins have a selective action on the nervous system, as in diphtheria, lead poisoning, syphilis, and other conditions. It is possible, therefore, that a toxin like that of syphilis may implicate the cochlear fibers and not the vestibular in the eighth nerve or the fibers of the horizontal or vertical canals alone. This is not always taken into consideration by the examiner, who assumes that whenever there is absence of response to the vertical, with presence of the response to the horizontal, there must be a lesion in the posterior cranial fossa. Sufficient experience with ear tests in functional and toxic cases has not accumulated to warrant conclusive opinions.

I do not wish to minimize the importance of these tests. On the contrary, I consider that a study of a lesion in the posterior cranial fossa is not complete without them. To my mind the vestibular tests are at least as important and probably more important than visual tests. But one should never make a diagnosis of intracranial lesion from the ear tests alone. The vestibular findings should be given due weight with the neurologic, visual, roentgen-ray, serologic and other findings, and the diagnosis made from the logical synthesis of all the results.

DISCUSSION

Dr. Charles K. Mills of Philadelphia said that he was emphatic in his belief in the existence of a cortical vestibular center. Dr. Weisenburg had not exactly denied this.

With regard to Dr. Weisenburg's criticisms of Dr. Dana's cases, Dr. Mills thought that they were justified at least with respect to one of them, although the other seemed to point fairly to a lesion in the temporal lobe. Possibly his own case was not without liability of challenge. Dr. Mills said it must be remembered, however, that vertigo may result from a lesion variously situated in the cerebrum. This well-known fact has led to some neglect of the study of vertigo which originates, as he believed, from temporal lesions. Exactly where the center or centers concerned with equilibration and orientation were situated he was aware that it was difficult to say. He believed, however, that this center or these centers were in the neighborhood of the parieto-tempero-occipital junction.

Wilson and Pike performed many experiments to determine the relations of the labyrinth to both the cerebellum and the cerebrum. These experiments were sometimes of destruction and sometimes of stimulation, mechanical or electrical. They experimented by removing the entire cerebrum and various portions of it. With regard to special localities their report was that the only consistent interference with the labyrinthine destruction or experimentation was when their operations were performed on the temporal lobe, or near it, probably meaning by this, near the tempero-parieto-occipital junction. When these temporal lesions were made, the quick component of nystagmus was diminished or decidedly interfered with. In one of Dr. Mills' cases an abscess occupying nearly the entire parietal lobe, as determined by necropsy, caused the abolition of the quick component in nystagmus when the labyrinth was stimulated by hot or cold water, rotation, etc.

Dr. Mills said that as every other cranial nerve had a cortical cerebral center, it was highly probable *a priori* that the vestibular nerve had its special center or centers in the cerebrum. It did not matter exactly how these centers were designated. In his scheme of cerebral centers he interrogated the term "equilibratory."

Dr. Weisenburg seemed in a way to acknowledge the existence of a special center for sensing movement. To Dr. Mills it did not seem possible to have the consciousness of a sense of movement without having also a consciousness of a sense of position; he asked whether position and movement were not the components of equilibrium?

Dr. Mills stated that the subject of aviation was interesting in connection with this discussion. In the account of the now famous aerial voyage half around the world—from London to Australia—the pilot, because of the continuous noise of the powerful engine, became totally deaf, so deaf that he was unable to hear a single word of what was said of him at a complimentary banquet at one of the stations in India at which he stopped. His hearing, however, returned in a short time. He was also for a time, owing to the condition of his goggles, scarcely able to see anything before or around him. Nevertheless, he guided his machine and undoubtedly had a clear appreciation of when he was rising or falling, or dipping to one side or the other. It might be said that he did this through his cutaneous and muscular senses, but it must be recalled that his feet, arms and body were not in contact with the earth, air or clouds through which he was passing. Unquestionably, in the belief of Dr. Mills, he was guided in considerable part by his equilibratory and orientation sense. If by some strange chance his cerebral centers for equilibration and spatial orientation had been blotted out during this voyage, even though he retained his hearing and sight and other senses, his power of controlling and guiding his machine would have been largely lost.

With regard to the cerebellum as a center for equilibration, Dr. Mills said that in a certain sense this might be accepted. To his mind, however, the cerebellum did not take part in the conscious sensation of movement, position or anything else. The cerebellum was a motor organ and its preeminent function was synergy. The fine adjustment of the body in station, gait, and movement of any sort could not be properly performed if the cerebellum was lacking or was decidedly diseased. It was through the cerebrum, however, that this lack and these disturbances were recognized by the individual, and this recognition came about largely through other centers than those concerned with vision, audition, cutaneous and muscular sensibility, taste and smell. In other words, he believed that there was a cerebral center or cerebral centers for spatial orientation.

Dr. William G. Spiller of Philadelphia acknowledged that he had been greatly aided in diagnosis of lesions of the posterior cranial fossa by means of the Bárány tests. It was undoubtedly true that a complete loss of function of the eighth nerve as shown by these tests was of great value in diagnosis of a suspected tumor of the cerebellopontile angle, but, as he had previously said, the converse was not true. It is possible that a lesion of the eighth nerve could cause a partial loss of function in the vestibular or cochlear portion, and such a partial loss does not indicate necessarily that the lesion is within the brain-stem where these fibers have separated. There is evidence to show that in other structures a similar condition might occur. The macular bundle of the optic nerve might be degenerated from pressure or intoxication without implication of the entire optic nerve. It was supposed at one time that a partial oculomotor palsy necessarily represented a nuclear lesion; but such an interpretation was not always correct, and a partial oculomotor palsy might result from a lesion at the exit of this nerve from the cerebral peduncle.

A similar degeneration occurs in the posterior roots in tabes. All sensory function is not immediately lost when these posterior roots degenerate, but, on the contrary, there is a dissociation of sensation. The Bárány tests should be valued, but their full interpretation has not yet been satisfactorily given, and the findings obtained by these tests should be weighed with the other clinical findings.

Dr. Harvey Cushing of Boston had been surprised in going over the records of temporal lobe lesions to find how frequently before operation it was almost impossible to tell the difference between what proved to be a temporal lobe lesion and a cerebellar lesion, and how often in these temporal lobe cases a definite nystagmus, vertigo and incoordination had existed. The hearing was rarely affected in temporal lobe lesions.

Dr. Cushing did not know whether there was a temporal representation of the vestibular nerve, but he thought the fact that persons with proved temporal lobe lesions had often given cerebellar symptoms was quite significant. It was not a matter that he had meant to touch on in his paper, but he thought it would be of interest in connection with the present discussion.

Dr. Walter F. Schaller of San Francisco said that it seemed to him that Drs. Weisenburg and Mills were particularly fitted to bring the subject before the Society, because in 1913 at the International Medical Congress in London they saw demonstrations by Bárány, and Dr. Schaller believed first presented his work to the neurologists in this country and stimulated Dr. Jones' work, which he acknowledges in his book, "Equilibrium and Vertigo."

Dr. Schaller made two points on the paper, one of which had been made by Dr. Mills, concerning cerebral localization. It seemed to him that the composite function which the writer characterized as equilibration must have a consciousness, and the cerebrum must be that organ of consciousness, and the disturbed function of that consciousness is vertigo. If we concede such consciousness it must be admitted the anatomic pathways to the cerebral cortex exist from all peripheral sense organs concerning equilibration, although these pathways have not been satisfactorily traced.

The second point was about the performance of the tests. Dr. Schaller had been very much interested in them, but would not want to have this work to do in addition to the general neurologic examination. He stated that these tests were quite technical, time consuming, and the results should be interpreted in conjunction with the general ear status. Dr. Schaller thought the report of the special examination by the otologist should be accepted in the same manner as the special eye examination, serologic and roentgenologic data. The ear tests in central nervous disease are only a part of the general neurologic picture.

Dr. Lewellys F. Barker of Baltimore called attention to a vestibulo-cerebral function that might advantageously be tested in some of these cases. It is by virtue of the vestibular mechanisms and their supranuclear connections that alterations of the rate of movement of the body in space can be recognized. When traveling in a sleeping car at night, one is unable to tell the direction in which the train is moving, except when starting or slowing up (linear acceleration). Again, when one is seated, blindfolded, in a rotating chair, the direction of rotation is not recognizable as long as the speed is constant, but the direction becomes known at once when the speed is altered (angular acceleration).

Dr. Israel Strauss of New York thought that all neurologists acknowledged a debt to the otologists for the work which they had done in this field. He thought also that the testing of the vestibular apparatus by the caloric method was just as important to them as the testing of reflexes, and that if they neglected this series of tests they were neglecting something exremely important in diagnosis.

However, there was one point which Dr. Strauss made. In cases of intracranial lesion Dr. Friesner and he had noticed that frequently the vertical canals failed to respond (the vertical canals of both sides), and they had found this to be so frequently the case in conditions in which the intracranial pressure was increased, whether the lesion was in the posterior fossa or whether it was in front of the tentorium, that they had come to disregard the absence of vestibular response to the vertical canals as being of no diagnostic significance.

Dr. George W. Hall of Chicago said it was self-evident that when tumors were present, the tests of Bárány could not be accurate in a great many instances, but it seemed to Dr. Hall that there was one clinical phenomenon, namely, occlusion of the posterior inferior cerebellar artery, in which these tests could be more accurately carried out following the technic of Fisher and Jones.

Dr. Hall reported two cases of that disease which had occurred within the last year and a half; in one case he was assisted by Dr. J. Gordon Wilson, the otologist at the Northwestern University Medical School; the lesion was a very limited one which cleared up. His conclusions, as far as the lesion was concerned in that case, were that both the horizontal and the vertical canals were involved. That was in contrast to a report by Jones and Fisher in a similar case in which they found that the vertical canals were not involved.

It was Dr. Hall's opinion from a clinical standpoint, that the greatest accuracy could be obtained through a limited lesion because there was the least amount of pressure to adjacent tissue.

Dr. Ernest Sachs of St. Louis said, in the work which Dr. Alvis and he reported before the American Neurological Association last year, they believed that because of the frequent association of internal hydrocephalus with a lesion in the posterior fossa the reason was apparent why the vertical canal so frequently did not respond to the Bárány tests. The work of Wilson and Pike, to which Dr. Mills referred, was not checked up by any histologic examination, at least according to their paper, and if the photographs of their specimens were studied, it was quite evident that in the methods used for removing portions of the cerebellum, they invariably injured the floor of the fourth ventricle and the region of the aqueduct of Sylvius, and these fibers ran down close to the floor of the fourth ventricle. Alvis and Sachs believed that this accounted for the frequent absence of responses of the vertical canal, because of this association of internal hydrocephalus with a lesion of the posterior fossa. They believed that the value of the Bárány tests was distinctly minimized. They did not think that they should not be made, for they had been using them for several years, but they believed that their value in localization was greatly reduced.

Dr. Hugh T. Patrick of Chicago had not seen Dr. Hall's case but had had occasion to go over his report, including the report of Dr. Wilson. From the reports he thought the examination of Dr. Wilson did not contribute to either the diagnosis or the localization.

Dr. Patrick mentioned the case of a man who had sustained, as the result of a fall from a horse, a double basilar fracture causing almost total deafness. After recovery, except for the deafness, he went into a river for a swim. He walked into the water above his waist and started to swim under water, whereupon he completely lost himself. He had no conception in which direction the atmosphere was, and that he nearly drowned before his head accidentally bobbed out of the water, when he opened his eyes, got his feet on the bottom and walked out.

Dr. Patrick agreed with Dr. Hall in every particular except in his conclusions from the vestibular examination. Dr. Wilson had been very conservative in drawing conclusions. He had the data of all the tests beautifully tabulated, but expressed practically no clinical opinion. It had seemed to Dr. Patrick that the tabulation of Dr. Wilson was not essential or valuable in making the diagnosis.

Dr. William G. Spiller of Philadelphia said that some years ago he had sent Dr. Isaac Jones a case of occlusion of the posterior inferior cerebellar artery as a test of the Bárány methods. Dr. Jones did not know the symptoms in the case or the history, but from the Bárány tests alone he came to the conclusion that the man had a lesion of the lateral part of the medulla oblongata, and his diagnosis was correct.

Dr. Wells P. Eagleton of Newark referred to a paper he had presented in 1912 before the American Otological Society, in which he reported three cases of tumor involving the vestibular areas. He had called attention to the fact that irrigation of the opposite vertical canal gave no reaction whatever, and then stated that this was in consequence of increased intracranial pressure and a manifestation of it. By the vestibular tests one cannot diagnose the difference between a cerebellar lesion or abscess and a temporal lobe lesion.

Dr. T. H. Weisenburg of Philadelphia, in closing, said that it was apparent from the discussion that practically everyone agreed as to the value of the Bárány tests. He wished, however, before closing to pay tribute to the excellent work of the otologists during the war.

As is well known, on our entrance into the World War, there were no uniform methods of examination for candidates for the aviation service. Largely through the work of Dr. Isaac H. Jones of Philadelphia, and Gen. Theodore Lyster of the Surgeon-General's office, standard ear tests were established and served as a means of elimination of the unfit.

The work of the medical section of the aviation service compared creditably with that of any other similar service in any other army. It was this work which aroused the interest of hundreds of otologists in the so-called Bárány tests. It would be a great pity if these men should lose their interest in neurology. Dr. Weisenburg thought that they should be encouraged in their work, and that neurologists everywhere should cooperate with them.

FACTORS INHIBITING THE RETURN OF MOTOR FUNCTION FOLLOWING NERVE INJURIES

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First Stage: *Period of Neuraxon Regeneration*

1. Determination of neuraxon regeneration
2. Muscle degeneration
3. Changes in joints and tendons
4. Sensory changes
5. Physiologic and mechanical factors entailed in suture which influence regeneration and ultimate function

Second Stage: *Period of Muscle Regeneration*

1. Muscle sense
2. Regenerative changes in muscles
3. Factors preventing the restoration of voluntary movement
4. Reeducation of muscle sense
5. Determination of motion
6. Substitution movements
7. Functional overlays

Third Stage: *Period of Muscle Training*

1. Factors responsible for defective motor restoration
    - (*a*) Number of physiologically active motor fibers
    - (*b*) Misdirected motor fibers
    - (*c*) Fibrotic muscles
    - (*d*) Muscle stretching
    - (*e*) Fibrotic joint changes
    - (*f*) Limitation of tendon movement
2. Reeducation of muscles
3. Development of amplitude of motion and strength

The study of over 1,500 peripheral nerve injuries in which we have been able to keep complete records of the disability—determined by individual muscle reaction and carefully recorded sensory examinations—reveals the existence of many factors which tend to inhibit the return of voluntary motor function. In about 500 cases operation was performed, consisting mostly of neurolysis, or end-to-end suture of the divided nerve. Grafts were used occasionally, but in most instances were later removed and end-to-end suture accomplished. Improvement in operative technic has almost entirely eliminated the necessity for grafts or other procedures for filling gaps.

While the factors considered in the present discussion pertain more especially to sutured nerves, many of these obstacles to successful motor restoration apply equally to nerves undergoing spontaneous regeneration. Clinically we have found it convenient to divide the period of regeneration into three stages, during any one of which progress may be retarded or arrested. Consideration in this way will frequently indicate at an early period factors interfering with regeneration which otherwise might remain unrecognized while needlessly awaiting the return of voluntary motion.

A study of the regenerative syndrome in patients under observation for periods ranging from one to three years following nerve suture, has indicated the nature of certain factors which inhibit the return of motor function after the nerve fibers apparently have been successfully regenerated. Such factors have not been fully appreciated and surgeons have resorted to repeated exposures of the nerve in order to remove scar tissue, or to attempt resuture, believing that regeneration of the nerve had been unsuccessful because of the absence of motor restoration.

THE FIRST STAGE OR PERIOD OF NEURAXON REGENERATION

The first stage is that of the regeneration of the neuraxons (axis cylinders) from the point of division, through the empty channels of the old nerve trunk to their respective end organs, and the reestablishment in motor and myosensory fibers of their neuromuscular junctions.

Determination of Neuraxon Regeneration.—We are familiar with only one method of determining nerve regeneration during the first stage, namely, Tinel's sign or formication—occasionally referred to as D. T. P. (distal tingling on percussion). It is a sensation of tingling, localized in the cutaneous sensory area normally supplied by the divided nerve, when the nerve at the point of division is irritated by percussion or pressure. The value of this sign rests in its interpretation. If in an injured nerve regeneration is completely arrested percussion of the nerve at the level of injury will cause this distal tingling, while percussion of the nerve distal to the lesion will not. If, however, the neuraxons are able to reach the distal segment of the nerve and continue their regeneration, it will be possible to elicit this sign at a lower level, and thus follow, from month to month, the distance down the nerve trunk to which the neuraxons have regenerated. In making this test some precautions are necessary. The extremity should be flexed sufficiently to relax the nerve (relaxation of the ulnar nerve requires extension of the forearm). If a nerve is percussed while stretched, or when incorporated in extensive scar tissue extending some distance below the injury, a certain amount of tugging is produced which may elicit the sign by stimulating fibers at a higher level. Gentle percussion or pressure should be made over the nerve beginning at its peripheral portion and gradually progressing upward until the distal tingling is elicited. At first the tingling will be very faint as the more advanced fibers are reached, but usually from this point upward the formication increases until we reach the point of division, where the reaction generally is strongest.

The intensity of this reaction depends on two factors: the number of sensory neuraxons being stimulated and the force of the mechanical irritation. The position of the nerve trunk—whether superficial or deep and its relation to underlying bone—greatly modifies the effectiveness of the stimulation, as does also dense surrounding scar tissue. These influences must be considered. The distal point at which this sign is elicited should be definitely noted at each examination; also its intensity as compared with that obtained at the level of the lesion. The regenerating neuraxon progresses about 3 to 5 cm. a month during satisfactory regeneration. Should the intensity of the sign be diminished and downward progress retarded, regeneration may be considered as being inhibited.

If three months after nerve division Tinel's sign is not elicited a few inches below the level of the lesion, it is suggestive of serious obstruction to regeneration, and operation is indicated, usually to remove scar tissue or bone callous. If Tinel's sign is elicited below the lesion with greatly diminishing intensity (as compared with that obtained at the level of the lesion), it indicates that only few sensory neuraxons have been successful in reaching the distal segment of the nerve; therefore surgical intervention is likewise indicated. Retardation of progress (measured from month to month) would indicate interference with regeneration, probably from scar tissue. Occasionally, after the neuraxons have succeeded in progressing some distance down the nerve, as determined by Tinel's sign, they may again be interrupted by the strangulating effect of scar tissue, producing secondary degeneration, in which case formication becomes fainter and is finally lost. Tinel's sign gives us information regarding sensory fibers only, but we believe that the motor fibers regenerate pari passu with the sensory ones. The value of Tinel's sign frequently has been questioned; but we believe that properly used it is of great value—in fact, is the only clinical means at our disposal for determining regeneration of the neuraxon during the first stage.

Changes in Denervated Muscles.—Muscles having been paralyzed by a division of their motor nerve, rapidly undergo degeneration and atrophy and after a few days begin to show the well-known reaction of degeneration. Untreated, denervated muscles frequently reach a point of almost complete fibrous or fatty transformation, and apparently lose all contractile power to any applicable stimulation.

The mechanical irritation of a denervated muscle gives certain reactions which seem to indicate the degree of its degeneration. Shortly after denervation, if its belly be struck with a percussion hammer, two reactions result: (1) a localized swelling, slowly developing and disappearing—due to stimulation of the sarcolemma (static element) in the muscle fiber (termed "idiomuscular reflex," though there is no reason why it should be considered as being reflex in nature); (2) a single rapid contraction of the muscle—closely resembling in effect the expression of a tendon reflex—due to stimulation of the disk system (kinetic element) and known as the myotatic reaction. Both are sometimes covered by the term direct myotatic irritability. With the progress of degenerative changes these reactions diminish, until, with complete degeneration of the muscle, they entirely disappear.

Denervated muscles not receiving proper care may undergo excessive stretching by the action of healthy antagonists, or may develop contractures of a fibrotic nature producing more or less deformity. If these complications remain uncorrected, they often prove to be serious obstacles to motor restoration.

Changes in Joints and Tendon Sheaths.—Improper splinting and the too prolonged use of properly applied splints, for the purpose of relaxing paralyzed muscles, often have been responsible for marked fibrotic changes in periarticular structures. Joints thus continuously limited in amplitude of motion almost invariably develop changes enforcing the limitation. They should be given careful daily manipulation throughout their physiologic range of motion. The same applies to tendons and their sheaths.

Sensory Changes.—The return of sensation in muscles usually is earlier than that of cutaneous sensibility, probably because the distance to be traversed by the regenerating muscle neuraxon is less. Cutaneous sensation is first indicated by a contraction of the field of anesthesia, in which complete anesthesia is replaced by paresthesia (tingling) and later hypesthesia. It is usually several years before the hypesthesia is completely replaced by acute discriminative sensitiveness.

Physiologic Factors Entailed in Suture.—Suture of mixed nerves (sensorimotor) frequently is followed by misdirection of fibers—"shunting"—in which cutaneous sensory fibers are approximated to and progress down motor channels to a muscle termination, or motor fibers are directed through sensory channels toward sensory end-organs. These misdirected fibers are physiologically lost. Again, fibers which formerly innervated a certain muscle may now be directed to a totally different muscle, resulting in loss of muscle coordination. That these complications are important in nerve surgery, we are convinced by the results observed in many cases. Every precaution should be taken to avoid torsion in nerve suture.

Mechanical Factors Inhibiting Regeneration.—The most frequent obstruction is scar tissue. Resection must remove all of that portion of the nerve which shows scar infiltration, or any great thickening of its sheath. Because of producing extensive defects, occasionally it is inadvisable to resect the nerve beyond the thickened portion of its sheath; after such a nerve has been approximated by suture, the sheath should be split for the purpose of decompressing the bundles. Many secondary operations call merely for this decompressive procedure. Avoidance of sepsis, tissue trauma and blood clots, will do more to prevent recurrence of scar tissue than any other means. Surrounding a sutured nerve with protective material, such as fascia, free fat transplants, veins, etc., is, we believe, usually productive of cicatricial tissue. The best protection for a nerve trunk seems to be its own sheath.

We are not convinced, in spite of many assertions to the contrary, that suturing a nerve under tension seriously retards regeneration—providing its approximation remains undisturbed. Some of our best terminal results have been in cases in which approximation was made with considerable tension.

THE SECOND STAGE, OR PERIOD OF MUSCLE REGENERATION

The second stage begins (clinically) with the return of muscle sense and is completed with the restoration of voluntary motion. Following the division of a motor nerve, there is loss of muscle sense, which is manifested clinically in several ways, but more particularly for our purpose in the psychologic loss of the paralyzed muscle. For instance, in a musculospiral paralysis the patient is unable to "place" any effort in his muscles to extend the hand. With the restoration of muscle sense, he feels that when he attempts to lift his hand he is definitely "placing" the effort, and that his hand should come up, even though there is no response. This we have chosen to call the psychologic restoration of muscle function and its presence is an early evidence of muscle regeneration. This psychologic return frequently precedes the return of voluntary movement by several months, but, occasionally, regeneration may be definitely prolonged in this stage.

Regenerative Changes in Muscles.—With the restoration of the motor and sensory end-plate in the degenerated muscle fiber, regenerative changes begin, indicated by modifications of the electrical and mechanical reactions. First, there begins to appear a slight sluggish reaction to galvanic stimulation, with polar inversion. Gradually, pari passu with regeneration, normal galvanic irritability is regained. Mechanical irritation presents a similar picture. At first there is only the slightest response which gradually increases and may become hyperactive just before voluntary motion returns.

Factors delaying the Restoration of Motion.—Psychologic: Often, though muscle sense has been regained, the patient is unable to force a voluntary impulse through the regenerated nerve. Apparently the patient realizes that he has moved the paralyzed muscles, but has forgotten the mechanism of the procedure. The first voluntary motion often comes as a surprise; its repetition may require great effort, and occasionally leaves the patient quite fatigued. Frequently voluntary motion may not be forthcoming until the patient's efforts are assisted. This is best done with galvanism. The galvanic shock is given to the muscles at regular intervals, at the operator's count, and with each count the patient strenuously endeavors to force through a voluntary impulse. Occasionally, though counting, the operator purposely fails to give the galvanic stimulus, and the patient's effort will frequently effect a movement. Such assistive treatment is of great value, but if applied without reference to the exact stage of regeneration, its use will prove less effective when the proper period arrives.

Muscle Stretching: Continued overstretching of a denervated muscle will prevent its response to volitional impulse after the nerve has been regenerated and muscle sense has been restored. Frequently muscles unopposed by their paralyzed antagonists develop physiologic shortening. This is a serious complication and can be prevented only by proper relaxation splinting and daily stretching of the normal muscles.

Fibrotic Muscle Changes: Occasionally the paralyzed muscles have undergone such complete fibrotic transformation, through lack of treatment and proper care, that recovery seems hopeless. On many occasions, however, they have gradually improved under massage and electrical treatment, though complete recovery seems improbable.

Reeducation of Muscle Sense.—Frequently patients with regenerating nerves feel able to move the paralyzed muscles though they cannot do so. The muscle sense may be assisted by galvano-psychologic treatment: The muscle is stimulated several times, and the patient asked to pay particular attention to the "feeling" produced by the contraction of the muscle and to try to duplicate that sensation by effort at contraction. This often assists the sensation of muscle effort and ushers in voluntary motion.

The Determination of Returning Voluntary Action.—The first sign of voluntary movement is very faint—only slight movement of the muscle tendon or of the muscle belly. In testing for the return of muscle action, of course, gravity should be eliminated.

Substitution or trick movements frequently are acquired in the attempt to simulate or replace the movements lost by reason of the paralysis. In the determination of returning voluntary power each muscle must be individually tested and motor function should be recorded in terms of individual muscle action.

Functional Overlays.—Sometimes when electrical and mechanical stimulation of the paralyzed muscles indicate satisfactory muscle regeneration, even to the point of restoration of faradic irritability, voluntary motion does not return. Such cases are probably functional, and careful examination of individual muscles will often demonstrate inactivity in muscles not originally paralyzed, and which should not be so from an anatomic standpoint. Psycho-therapy is then indicated.

Functional overlay in peripheral nerve lesions has been infrequent; it has probably occurred in less than 2 per cent. of the cases. In a number of cases suspected of hysterical overlays, careful study revealed other factors—particularly the persistence of substitution movements retained by habit. These cases yielded to psychologic correction and training.

THE THIRD STAGE, OR PERIOD OF MUSCLE TRAINING

The third stage continues from the first appearance of voluntary motion until attainment of efficient function. After the first return of voluntary motion recovery must by no means be considered assured, nor should treatment be discontinued. Many factors remain which might be responsible for persistence of defective function.

Factors Influencing Muscle Power and Coordination.—(*a*) The number of motor fibers reaching the paralyzed muscle depends on the successful regeneration of the neuraxons. Motor fibers directed into physiologically differentiated channels, and sensory neuraxons reaching the motor end-plate cause disability difficult to correct. In some cases in which motor and sensory restoration was very defective, pressure on the muscle belly produced intense tingling localized in the cutaneous distribution of the injured nerve. The myotatic irritability of a muscle gives considerable information regarding the number of motor fibers which have reached that muscle. For instance, after a musculospiral injury there is occasionally a return of strong voluntary power in the radial carpal extensors, the myotatic irritability of these muscles being very pronounced (plus 4), while regeneration in the extensor carpi ulnaris is very defective, with a myotatic irritability expressed by plus 1. This defective restoration can usually be predicted by the degree of mechanical irritability long before voluntary power has returned. The degree of myotatic irritability usually indicates the extent of muscle regeneration, which, in turn, presumably depends on the number of regenerated motor neuraxons.

(*b*) Fibers which formerly innervated certain muscles may now be directed to others; this is particularly common in brachial plexus lesions, and is manifested clinically by defective coordination. For instance, attempts at extension of the wrist result in contractions in the brachioradialis (supinator longus), producing flexion of the forearm, the simultaneous contraction of the brachioradialis with the biceps being absent.

(*c*) Fibrotic changes in muscles are more often observed in patients having a concomitant vascular lesion or those having been subjected to prolonged splinting. Fibrotic muscular infiltration persisting after apparently normal downgrowth of neuraxons (determined by Tinel's sign), we believe depends on "shunting," the absence of sufficient normal motor and sensory fibers. In ischemic paralysis, whether or not associated with a primary nerve lesion, the fibrotic change in the muscles is also found in the nerve and partakes of the nature of a perifunicular fibrosis. These fibrous changes within the nerve we believe are frequently responsible for continued disability, the degenerative changes in the muscles probably persisting because of impaired nervous control after circulatory compensation has been attained.

(*d*) A muscle which is persistently overstretched will not develop voluntary power to any degree, so long as the stretching is continued. Muscles which have regenerated to the point of definite voluntary contractions, may completely lose their power if allowed to be stretched by the too early removal of relaxation splints. We have seen normal muscles subjected to prolonged splinting and overstretching lose their function and their electrical and mechanical irritability. Constant vigilance and care, especially in paralysis below the knee, are necessary to prevent this overstretching. Muscle stretching is often produced through trick movements in the patient's efforts to use an extremity which is not properly splinted.

(*e*) Periarticular fibrotic changes from immobilization and their avoidance have already been noted. The metacarpophalangeal joints are the most frequent source of trouble. A "cock-up" splint for musculospiral paralysis, because of this susceptibility in the metacarpophalangeal joints, should never extend beyond the transverse markings of the palm.

(*f*) Changes within the tendon sheaths from immobilization and their prevention have been mentioned in the foregoing.

Muscle Reeducation.—The reeducation of muscles is made necessary through "shunting" or misdirection of nerve fibers. In brachial plexus lesions, sometimes when recovering spontaneously, but more frequently after suture, this misdirection of fibers is easily shown. For instance, when percussion over the musculospiral nerve induces tingling in the little finger, it indicates that musculospiral fibers have gone into the ulnar nerve. After the return of voluntary muscle action attempts to extend the forearm may result in its flexion, or the endeavor to extend the wrist may produce contraction in both flexors and extensors. These mishaps in the direction of motor fibers necessitate first a psychologic correction before the attempt is made to develop range or power. Each defective movement should be demonstrated to the patient, with the method of correction. After he has made the corrected movement the muscle sense or mechanism required to produce that particular movement should be carefully studied and the movement repeated until it can be readily reproduced at will. At first the movements should be slow and accurate; later, as they are perfected, rapidity is encouraged—rapid movements tend toward the conversion of the psychologically directed impulses into habit complexes. Reeducation is also used for the elimination of substitute or trick movements.

With the return of voluntary action, amplitude of motion and strength are greatly limited. The correction should be directed first toward improving the amplitude of motion by assistive exercises. After normal amplitude has been regained, strength probably is best acquired by resistive exercises.

CONCLUSION

The division of the period of nerve and muscle regeneration into definite stages has proved to be of considerable value in dealing with the patients. Tinel's sign and the return of muscle sense are only subjective expressions of regeneration, but usually are very definite. The different muscles of an extremity may be found in various stages of regeneration, so that it is only by a careful study of individual muscle reaction that the true status of regeneration can be determined. We believe that a fuller appreciation of the various factors active in retarding both nerve fiber and muscle regeneration will contribute largely to the prevention of many disabling residua which are more or less common to all nerve lesions.

THE COLLOIDAL GOLD CHLORID CURVE IN EPIDEMIC ENCEPHALITIS *

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As the cerebrospinal fluids of several patients in the Michael Reese Hospital who had epidemic encephalitis at about the same time showed similar gold chlorid curves—a change to violet in the syphilitic zone—it seemed advisable to look up the spinal fluid findings of other patients with this disease who had been in the hospital. It appeared important also to attempt to correlate the colloidal gold chlorid curves in the entire series with the other changes in the fluids, to determine whether the laboratory examination of the spinal fluid in this disease might yield any findings which, considered in relation to each other, would be of diagnostic aid.

The colloidal gold chlorid solutions used in the tests conformed with the usual requirements, that is: 1. The fluids were deep red, clear to both direct and transmitted light. 2. They were neutral to 1 per cent. solution of alizarin red in 50 per cent. alcohol. 3. Five cubic centimeters of each solution were completely precipitated in one hour by 1.7 c.c. of 1 per cent. sodium chlorid. 4. Each fluid gave a typical curve with a known paretic spinal fluid and no curve with a normal spinal fluid.

Of thirty-eight cerebrospinal fluids for which the gold chlorid curve is recorded, seven (Group 1, Table 1) gave no color change with colloidal gold chlorid solution. These fluids were examined from six days to seven months after the onset of the symptoms. There was nothing characteristic in the total cell count. It ranged from 2 to 212, with a mononuclear percentage varying from 60 to 100. Globulins (Noguchi and Ross-Jones methods) were present in five of the seven fluids of this group. The Wassermann reaction (cholesterinized, lipoid and syphilitic antigens) was negative in all.

Fourteen of the spinal fluids (Group 2, Table 1) changed colloidal gold chlorid solutions to red blue in the lower spinal fluid dilutions. This color change, which frequently occurs with normal spinal fluids, never extended above the sixth tube. These fluids were drawn from one to eight weeks after the onset of symptoms, with the exception of No. 29, which was obtained from a patient who had a definite history of epidemic encephalitis two years before entering the hospital and who had had cerebrospinal symptoms at intervals since that time. This group also showed great variation in the cell count, the total count

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* From the Nelson Morris Memorial Institute for Medical Research of the Michael Reese Hospital.

varying from 2 to 220 and the mononuclear percentage from 40 to 100. The globulins were negative in three of the fourteen fluids of this group and the Wassermann reaction was negative in all.

Seventeen of the spinal fluids (Group 3, Table 1) gave a colloidal gold chlorid curve above red blue in the lower fluid dilutions. These fluids were taken from three days to four weeks after the onset of the disease. The variation in the total and in the differential cell counts was as great in this group as in Groups 1 and 2; the total count varied from 7 to 400, the mononuclear percentage from 40 to 100. The globulins were positive in all of this group and the Wassermann reactions were negative with the exception of No. 32, which was weakly positive with a cholesterinized antigen only. This fluid and fluids No. 11 and No. 21 of Group 3 gave typical paretic curves with

TABLE 1.—RESULTS OF LANGE'S COLLOIDAL GOLD TEST

Case No.	Time Since Onset of Disease	Cell Count			Globulin	Wassermann Reaction	Colloidal Gold Chlorid Curve
		Total	Per Cent. Polymorphonuclears	Per Cent. Mononuclears			
Group 1							
3	14 days	212	40	60	+	0	0000000000
7	3 weeks	9	0	100	+	0	0000000000
13	7 months	...	..	...	..	...	0000000000
17	14 days	59	10	90	+	0	0000000000
	6 weeks	155	10	90	+		
18	10 days	46	8	92	0	0	0000000000
19	3 weeks	2	0	100	0	0	0000000000
21	6 days	110	0	100	+	0	0000000000
Group 2							
1	3 weeks	35	0	100	+	0	0111100000
2	3 weeks	20	0	100	+	0	1111000000
4	10 days	40	50	50	+	0	1110000000
	13 days	28	20	80	+		
5	5 weeks	26	60	40	+	0	1111000000
8	7 days	29	0	100	+	0	1111000000
10	14 days	27	0	100	+	0	0011100000
12	3 weeks	3	0	100	+	0	0011110000
15	7 days	3	0	100	+	0	0011110000
16	9 days	2	0	100	0	0	0001110000
20	3 weeks	6	0	100	0	0	1111100000
21	10 days	220	20	80	+	0	1110000000
27	8 weeks	13	0	100	+	0	1110000000
28	4 weeks	28	0	100	+	0	0011100000
29	2 years	2	0	100	0	0	1111100000
Group 3							
6	14 days	35	0	100	+	0	0122100000
	19 days	20	0	100	+		
9	3 weeks	23	0	100	+	0	1234221000
14	4 weeks	26	10	90	+	0	0011210000
22	13 days	400	40	60	+	0	Blood
	20 days	80	0	100	+	0	0012210000
23	12 days	130	0	100	+	0	1221000000
	19 days	...	..	...	+	0	1122110000
24	3 days	145	15	85	+	0	1222220000
	15 days	10	0	100	+	0	0122220000
25	7 days	40	0	100	0	0	1122110000
26	21 days	130	60	40	+	0	0023210000
	31 days	20	20	80	+	0	0034320000
30	7 days	7	0	100	+	0	0122100000
31	6 days	7	0	100	+	0	0122100000
32	9 days	7	0	100	+	+	4444400000
	17 days	7	0	100	+	0	0113320000
11	3 weeks	17	0	100	+	0	5555532000
21	25 days	80	0	100	+	0	5550000000

the gold chlorid solution. There were no symptoms or history of syphilis in these three instances. When spinal fluid was taken in Case 32 one week later, the Wassermann reaction was completely negative and the gold chlorid curve had changed from 4444400000 to 0113320000.

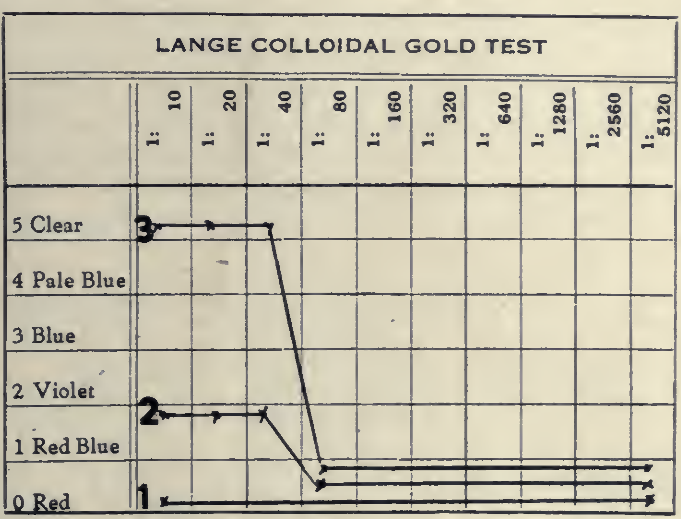

Chart 1.—Examination of spinal fluid six days (Curve 1), ten days (Curve 2) and twenty-five days (Curve 3) after onset of symptoms of epidemic encephalitis.

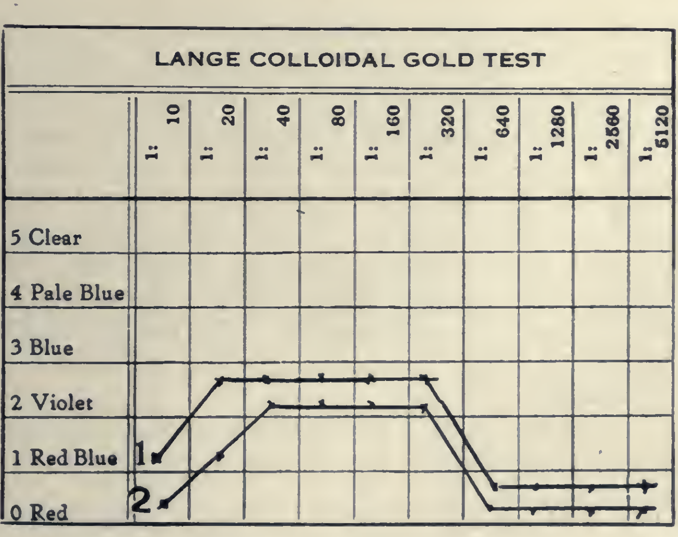

Chart 2.—Examination of spinal fluid three days (Curve 1) and fifteen days (Curve 2) after onset of symptoms of epidemic encephalitis.

Spinal fluid from several cases was examined more than once (Table 2). The same colloidal gold chlorid solution was used in these repeated tests. In Case 21, (Chart 1) the fluid was obtained on the sixth, tenth and twenty-fifth days after the onset of symptoms. On the sixth day the colloidal gold chlorid curve was negative, on the tenth day 1110000000, and on the twenty-fifth day 5550000000. The total and differential cell count varied also, but there was no relationship between their variation and the curves since the counts were nearly alike on the sixth and on the twenty-fifth day, when there was the greatest variation in the colloidal gold curve. Fluid from Case 23 was obtained on the twelfth and on the nineteenth day and the curves were quite similar. Fluid from Case 24 (Chart 2) was taken on the third and on the fifteenth day. The colloidal gold curves were similar, although there was a marked difference in the cell counts. Fluid from Case 26 (Chart 3) was obtained on the twenty-first and on the thirty-fifth day. There was a greater change in the colloidal gold curve on the thirty-first day, although the cell count was considerably lower at that time. Fluid from Case 32 (Chart 4) was obtained on the ninth and on the seventeenth day. The cell counts and the globulins were identical in the two fluids. The Wassermann reaction on the ninth day was weakly positive, and the gold chlorid curve was 4444400000. On the seventeenth day the Wassermann reaction was negative and the curve was 0113320000. This change in curve is the reverse of that in Case 21 (Chart 1), which increased in reaction late in the disease.

TABLE 2.—Repeated Examinations of Cerebrospinal Fluids

Case No.	Time Since Onset of Disease	Cell Count			Globulin	Wassermann Reaction	Colloidal Gold Chlorid Curve
		Total	Per Cent. Polymorphonuclears	Per Cent. Mononuclears			
21	6 days	110	0	100	+	0	0000000000
	10 days	220	20	80	+	0	1110000000
	25 days	80	0	100	+	0	5550000000
23	12 days	130	0	100	+	0	1221000000
	19 days	...	..	...	+	0	1122110000
24	3 days	145	15	85	+	0	1222220000
	15 days	10	0	100	+	0	0122220000
26	21 days	130	60	40	+	0	0023210000
	31 days	20	20	80	+	0	0034310000
32	9 days	7	0	100	+	+	4444400000
	17 days	7	0	100	+	0	0113320000

The precipitation reaction with colloidal benzoin[1] was performed with thirteen spinal fluids in order to determine whether there was any relationship between the two colloidal reactions in epidemic encephalitis. None was found. Eight fluids (Nos. 21, 22, 23, 25, 26, 30, 31 and 32 of Group 3), which gave color changes with colloidal gold chlorid solutions, gave no precipitation with colloidal benzoin. In Nos. 27, 28 and 29 (Group 2), the colloidal gold changed only to

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[1] Guillain, G.; Laroche, G., and Lechelle: Réaction précipitation du benjoin colloidal avec les liquides pathologiques, Compt. rend. Soc. de biol. **83:**1077 (July 17) 1921.

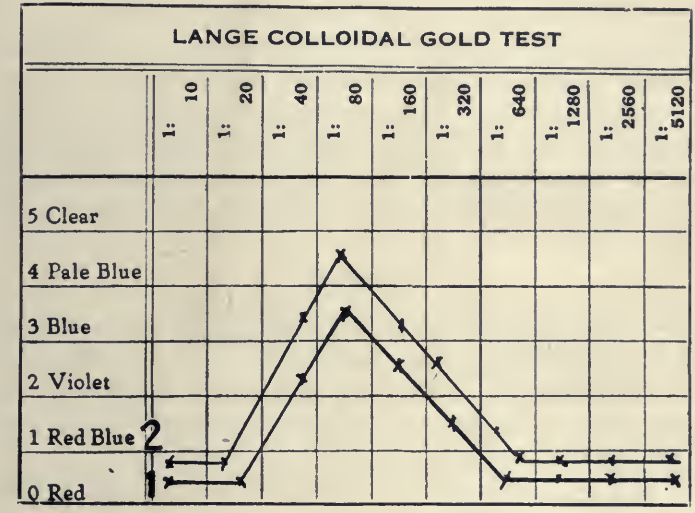

Chart 3.—Examination of spinal fluid twenty-one days (Curve 1) and thirty-one days (Curve 2) after onset of symptoms of epidemic encephalitis.

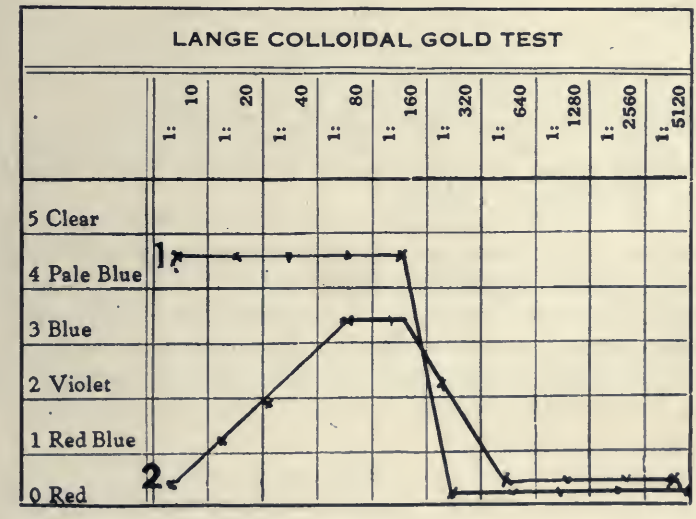

Chart 4.—Examination of spinal fluid nine days (Curve 1) and seventeen days (Curve 2) after onset of symptoms of epidemic encephalitis.

blue red while the colloidal benzoin precipitated from the seventh to the sixteenth tube. In No. 32, fluid of the seventeenth day, the gold chlorid curve reached violet and the benzoin precipitated from the second to the fifth tube.

Cultures of the fluids were made by aerobic and anaerobic methods. The mediums used were ascites fluid plus sterile rabbit kidney tissue, ascites dextrose broth, ascites dextrose agar and blood agar. Nothing was isolated that was considered a probable cause of the disease. The cultures were usually sterile, even after the duration of weeks and months. A gram-positive diplococcus was isolated twice and a diphtheroid bacillus once. The ascites rabbit tissue cultures were especially examined for "globoid bodies." In a few films globoid-like bodies were seen, but similar bodies were seen also in preparations from the control tubes.

SUMMARY

No characteristic colloidal gold chlorid curve was obtained with cerebrospinal fluids in epidemic encephalitis. When there was a color change, it ocurred in the lower spinal fluid dilutions (syphilitic zone). This result agrees with those in the recent publications of Davis and Kraus,[2] Happ and Mason,[3] and Neal.[4]

There was no relation between the colloidal gold chlorid reaction and the duration of the disease.

The colloidal gold chlorid curve apparently was not influenced by the total cell count, nor by the polymorphonuclear or mononuclear leukocytic percentages.

The colloidal gold curve did not depend on the globulin content of the fluids.

There was no relationship between the colloidal gold chlorid reaction and the colloidal benzoin precipitation reaction.

The Wassermann reaction with all fluids was negative.

Spinal fluid from a patient with epidemic encephalitis may give a typical paretic curve with colloidal gold chlorid when there are no symptoms or history of syphilis.

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2. Davis, T. K., and Kraus, W. M.: The Colloidal Gold Curve in Epidemic Encephalitis, Am. J. M. Sc. **586**:109 (Jan.) 1921.

3. Happ, W. M., and Mason, V. R.: Epidemic Encephalitis. A Clinical Study, Bull. Johns Hopkins Hosp. **32**:137 (May) 1921.

4. Neal, Josephine B.: Experience with More than One Hundred Cases of Epidemic Encephalitis in Children, J. A. M. A. **77**:12 (July 9) 1921.

Special Article

A REVIEW OF RECENT LITERATURE ON NEUROSYPHILIS

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The news of another edition of Nonne's "Syphilis und Nervensystem" will be received by those interested in the subject of neurosyphilis with mingled sensations of delight and tribulation. Having been for so long a classical reference book on neurosyphilis, it is necessary only to call attention to the new edition.

A new book on the subject of neurosyphilis by Wilhelm Gennerich [1] is a notable recent contribution to the study of neurosyphilis. A review of this book appeared in the October number of the ARCHIVES, and I will only say that I consider this the most important work on the treatment of neurosyphilis that has been published to date. It merits conscientious study by all who treat or outline treatment for patients with syphilis of the central nervous system.

STRAINS OF SPIROCHETES WITH PREDILECTION FOR THE NERVOUS SYSTEM

Probably, one of the most important subjects in the consideration of neurosyphilis relates to the question of whether there are strains of spirochetes which have particular predilections for the central nervous system. A. Marie and C. Levaditi [2] present an important contribution. In this article, of some length, they review the various theories suggesting a neurotropic strain, calling attention to the infrequency with which patients with neurosyphilis have had active skin lesions and discussing the frequency with which the mates of neurosyphilitic patients and patients infected from the same source develop neurosyphilis. This introduction to their experimental work contains a good review of the literature on the subject, but the important part of the work deals with their experimental studies. They report that in 1913 they inoculated a rabbit from the blood of a patient with general paresis. The infection took, and it was passed through three generations of rabbits. The incubation period was two or three times longer than the habitual incubation period from spirochetes obtained from primary lesions. The work was largely interrupted by the war, but since the armistice the authors have continued their work and claim to have confirmed their former findings. They also state that rabbits successfully inoculated from the blood of a paretic patient are not immune to spirochetes obtained from other sources. They thus indicate that the immunity secured from a syphilitic infection acquired through an infection by spirochetes from a paretic patient does not hold for spirochetes obtained from another source. A summary of their findings follows:

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[1] Gennerich, Wilhelm: Die Syphilis des Zentralnervensystems. Ihre Ursachen und Behandlung, Berlin, Springer, 1921.

[2] Marie, A., and Levaditi, C.: Special Type of Spirochete Responsible for General Paresis, Rev. de méd. **37**:193, 1920.

In the dermatropic strain the average incubation period is forty-two days whereas in the neurotropic the average is ninety-five days. When a second passage to an animal is made the incubation period habitually is decreased, and in the case of the dermatropic strain it is reduced to fifteen days on the average, whereas with the neurotropic strain the average incubation period is seventy-five days. Pathologically, the primary lesion differs in the two strains. The chancre from the dermatropic strain is indurated with marked ulceration at the border of the inoculation, whereas with the neurotropic strain the chancre appears as an erosion or papulosquamous lesion with slight ulceration and desquamation. The dermatropic strain leads to an endo-arteritis and peri-arteritis with intense infiltration. The neurotropic strain produces perivascular lesions with little endarteritis. In the former a great deal of new connective tissue is produced, whereas in the latter there is little. These experiments were carried out on the rabbit. The authors found that the dermatropic strain was easily transmitted to the monkey, whereas they were unable to pass the neurotropic strain to this animal. They were able to obtain a successful inoculation of the dermatropic strain with man, but in one man on whom inoculation with the neurotropic strain was attempted they were unsuccessful. These experiments of Marie and Levaditi are most illuminating, but it is doubtful whether they are entirely convincing. The inability to transmit the so-called neurotropic strain to monkey and man is open to the criticism of having been tried in only a few instances, and failure to transmit from experimental animals to monkey or man may be open to many explanations aside from that of being due to a particular or specific strain. Nor are the differences in the pathologic examination of the lesion produced easy to interpret. A slowly developing lesion would naturally give a different pathologic picture than one rapidly produced, and it must be noted that in the second passage the chancre appeared in fifteen days after the inoculation as compared with seventy-five days in the second strain. As to the time relations, it is well known that the incubation period for syphilis produced experimentally varies considerably. It is known, too, that the spirochete after being cultivated is not as virulent as when obtained from a fresh lesion. There are, therefore, a number of considerations which make one hesitate to accept Marie and Levaditi's findings as adequate proof of the specificity of strains for general paresis. This work, however, paves the way for further experimentation and must be considered one of the important contributions to the subject.

The work of Brown and Pearce on experimental syphilis at the Rockefeller Institute has shown some interesting features in line with those of Marie and Levaditi's. They have shown the possibility of superinoculations or a successful "take" of the second inoculation of an animal that has already been infected with syphilis. This would again argue for the difference in strains. But Brown and Pearce have been chary in reporting any far-reaching conclusions concerning the immunity problem, and we must await their further study.

The question of strains of spirochetes is approached from a different point of view by Fleming.[3] The author calls attention to the six surviving members in a family of eight born of healthy parents. Four acquired syphilis from different sources and developed tabes dorsalis. The fifth member of the family gave a history of gonorrhea (probably acquiring syphilis at the time) and was in an early stage of tabes. It is suggested in the light of these facts that tabes dorsalis cannot be attributed to a special strain of spirochete introduced at the initial infection; but is more probably due to the spirochete acting on tissues specially sensitized either by natural family peculiarity or by certain methods of treatment. This is the classical method of attack on the problem and is one more addition to the vast collection of facts. These facts, however, are exceptional and should not be given too much weight.

The point suggested in the last reference as to the effect of treatment in the production of syphilis of the central nervous system harks back to the problem of so-called "arsphenamin neurorecidives." It will be remembered that following the introduction of arsphenamin as a therapeutic agent there was much discussion as to whether neurosyphilis occurred with greater frequency than previously. This subject is again taken up by J. E. McDonagh,[4] who believes that arsphenamin tends to produce early neurosyphilis. This matter is discussed at great length in Gennerich's [1] book. He states these views:

In practically all cases of early syphilis there is an invasion of the central nervous system by the spirochete. Ordinarily the natural immunity of the person is able to overcome this involvement. Arsphenamin, by rapidly killing a large number of organisms, reduces the immunity reaction of the person because this high active immunity is no longer needed. Thereupon the spirochetes which may have been left in the central nervous system have a chance to multiply with less opposition, and an active neurosyphilitic lesion results. This may be overcome by a continuation of treatment of the proper type. A critical discussion of Gennerich's view on this and several other points is given by Matzenauer.[5] The whole question is still in a relatively unsatisfactory state; its final solution has not yet been reached.

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[3] Fleming: Familial Tabes Dorsalis, J. Neurol & Psychopath. **1:** No. 3 (Nov.) 1920.

[4] McDonagh, J. E.: Early Nervous Syphilis After Arsenobenzene, Brit. J. Dermat. & Syph. **32:**29, 1920.

CONSIDERATION OF CENTRAL NERVOUS SYSTEM IN EARLY SYPHILIS

Much attention has been given to the evidence of the early infection of the central nervous system by the spirochete. This subject was first definitely approached by Wile and Stokes in 1915. Wile and Hasley[6] publish their observations to date. A series of 221 cases of syphilis, in which only the chancre was present in 22 per cent., presented a few deviations in the spinal fluid content. The most interesting fact in their observations is that the spinal fluid Wassermann reaction may be positive before it becomes positive in the blood.

McIver[7] in a study of the spinal fluid of ninety-one patients with syphilis in the primary and secondary period, draws these conclusions:

1. Slight increase in lymphocytosis occurs in the majority of cases.
2. Increase in the protein does not occur as early as increase in lymphocytosis.
3. No patient gave a strong positive Wassermann reaction in the fluid using 0.6 c.c. of fluid.
4. It does not seem reasonable to conclude that the spinal fluid examination will indicate which patients will develop symptoms of central nervous system syphilis.

Cornaz[8] found that in 35 per cent. of the cases of early syphilis, pleocytosis had occurred before the appearance of cutaneous or mucous lesions. In the exanthematous stage 14 per cent. of the cases gave a positive Wassermann reaction; 13 per cent. of patients with condylomas had positive Wassermann reactions in the fluid, and in only one of the twenty-five patients with mucous patches was the Wassermann reaction positive in the fluid.

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[5] Matzenauer: Zur Frage der endolumbalen Salvarsanbehandlung und über den Einfluss der Behandlung auf Immunkörperbildung und den weiteren Krankheitsverlauf der Syphilis, Wien. klin. Wchnschr. **32**:831-835, 1919.

[6] Wile, Udo J., and Hasley, C. K.: Involvement of the Nervous System During the Primary Stage of Syphilis, Continued Study, J. A. M. A. **76**:8 (Jan. 1) 1921.

[7] McIver: The Spinal Fluid in Primary and Secondary Syphilis, J. A. M. A. **73**:1765 (Dec. 6) 1919.

[8] Cornaz: Study of the Cerebrospinal Fluid in Different Periods of Syphilis, Cor.-Bl. f. schweiz. Aerzte **48**:1584, 1918.

Nicolau[9] studied fifty-one cases of primary syphilis prior to the appearance of secondary manifestations. In eighteen, the spinal fluid showed definite lymphocytosis. The lymphocytosis made its appearance usually in the beginning of the third week. It may, therefore, be considered, with adenopathy, as one of the earliest manifestations of a general infection. Of the eighteen patients with lymphocytosis, an inequality of the pupils was noted in eleven, whereas of thirty-three patients without lymphocytosis pupillary inequality was noted in five. Nicolau therefore concludes that inequality of the pupils is highly suggestive of cerebrospinal lymphocytosis. The lymphocytes increased with the appearance of the secondary stage. A satisfactory review of the spinal fluid findings in early syphilis is given by Klauder.[10]

It has been definitely shown that in many cases the cerebrospinal axis is infected by the spirochete early in the course of syphilis. Treatment of early syphilis therefore involves a consideration of the central nervous system. Nicolau,[9] says that in only one of his series of eighteen cases with lymphocytosis in the primary stage did treatment cause the lymphocytosis to disappear. In three cases further increase was arrested. In the fourteen remaining cases, the development of the lymphocytosis was not affected by the general treatment, although this treatment was sufficiently intensive to suppress all secondary manifestations. He therefore cautions that a persistently negative Wassermann reaction obtained by treatment in the early stage, even in the absence of any secondary symptoms, is not to be depended on as indicating an abortion or cure of syphilis. There must also be evidence of nonirritation of the cerebrospinal fluid. I believe this is one of the most valuable dicta recently enunciated. It is a matter which rarely comes into the purview of the neuropsychiatrist, and too frequently the syphilologist is not sufficiently keen in considering the central nervous system. Manifestations of the central nervous system are not rare in persons who have received the so-called "abortive treatment," beginning in the primary period before the Wassermann reaction has become positive. These patients, often discharged as cured, later show symptoms of syphilis of the central nervous system.

Scott and Pearson,[11] in dealing with the problem of the early involvement of the central nervous system, come to practically the same conclusions as Nicolau. Scott and Pearson state that in the early period general systemic treatment may suffice but that later when neurologic signs have appeared intraspinal treatment is necessary. Larkin and Cornwall[12] agree a little more closely with Nicolau and state that general systemic treatment is not sufficient to produce a negative spinal fluid, but that this may be accomplished by intraspinal treatment. Gennerich is of a similar opinion and gives many interesting illustrations in his book. For the same reason Fordyce has been an active advocate of intraspinal treatment. Although not entirely in accord with these statements, I agree that in many cases in which general treatment consists of a series of six or eight injections of arsphenamin followed by mercury, the spinal fluid remains positive. However, if treatment is given more intensively and over a longer period of time, using larger doses of arsphenamin more frequently repeated than is the routine in the majority of these early cases, the spinal fluid may be brought back to normal. In cases of early involvement of the central nervous system, as shown by the spinal fluid findings, treatment which is sufficient to suppress the ordinary secondary skin manifestations may be inadequate for the sterilization of the central nervous system. Therefore the neuropsychiatrist who is interested in the prevention of neurosyphilis should take an active interest in early syphilis; if he himself is not to treat the disease at this stage, he should stimulate the syphilologist to an interest in the central nervous system.

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[9] Nicolau: Recherches sur le liquide cephalo-rachidien dans la periode primaire de la syphilis (Studies of the Cerebrospinal Fluid in Primary Syphilis), Ann. de dermat. et syph. **7**:200 (July) 1919.

[10] Klauder: Early Neurosyphilis Asymptomatica with Report of Observations and Cases, Am. J. Syphilis **3**:559, 1919.

[11] Scott and Pearson: Some Observations on Syphilis of the Central Nervous System, Am. J. Syphilis **4**:201-252, 1920.

Fildes, Parnell, and Maitland[13] emphasize the necessity of consideration of the central nervous system in cases of syphilis, especially in the early stages. They examined 624 syphilitic men, of whom the majority were in the early stages and showed no obvious signs of syphilis of the nervous system. Eighteen per cent. showed undoubted abnormal conditions of the central nervous system. If the cases considered as doubtful were included, the percentage would be 30. There is a progressive increase in occurrence up to the secondary stage but a slight decline in the later manifest secondary and tertiary period. In men in the so-called "latent stage," there is a pronounced increase in the number affected. In this series, of all men who had been affected for more than six months and showed no symptoms, 35 per cent. had abnormal central nervous systems. The series includes a large number of patients in the first weeks of the disease, which would bring down the percentage incidence of central nervous system involvement. The onset of abnormality occurred in two cases before the Wassermann reaction had become positive in the serum. The real difficulty is a syphilitic meningitis. Polymorphonuclear leukocytes occurred frequently in the more pronounced cases. The outstanding feature was the lack of symptoms. Few men complained of disability even when the meningitis was acute enough to produce a visible opalescence in the cerebrospinal fluid. A number showed beginning retinitis.

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[12] Larkin and Cornwall: The Value of Laboratory Diagnosis in Neurosyphilis, Am. J. Syphilis **3**:76-87 (Jan.) 1919.

[13] Fildes, Parnell and Maitland: The Occurrence of Unsuspected Involvement of the Central Nervous System in Unselected Cases of Syphilis, Brain **41**:255, 1918.

CONGENITAL SYPHILIS

Of equal importance to the examination of the spinal fluid in cases of acquired syphilis is the examination in the cases of congenital syphilis. Kingery [14] gives an interesting study of the spinal fluid in cases of hereditary syphilis. He quotes Jeans [15] who examined 214 cases of congenital syphilis, combining the results of lumbar puncture and careful clinical examinations. Jeans found that approximately one third of his patients had definite involvement of the central nervous system. Kingery's fifty-two patients ranged in age from 3 weeks to 21 years. Routine punctures were made on all patients. The spinal fluid of fifteen, or 28.8 per cent., showed some deviation from the normal spinal fluid, four showed mild changes and eleven marked changes. These findings would definitely prove that the consideration of congenital syphilis should loom large in the work of the neuropsychiatrist.

Camp,[16] in considering the mastic test on the cerebrospinal fluid, says that it is more reliable than the colloidal gold test. He advocates the use of both tests in the examination of the cerebrospinal fluid.

Stokes and Busman,[17] in a consideration of the so-called "Wassermann-fast" cases, that is, patients whose blood Wassermann reaction does not become negative under treatment, found that 30 per cent. of these cases were neurosyphilitic. It is, therefore, obvious that one must consider the central nervous system of all patients with syphilis in whom the blood Wassermann reaction does not readily become negative under treatment.

Clinical observation of congenital syphilis has shown that various types of dystrophy suggesting disorder of the glands of internal secretion are not rare. Nevertheless, the literature is peculiarly deficient of any consideration of this subject. It is, therefore, especially pertinent to call attention to the chapter in Hazen's [18] book on syphilis, in which he deals with the affections of endocrine glands both in the acquired and congenital forms of the disease. It would seem that more work on this subject is greatly needed.

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[14] Kingery: A Study of the Spinal Fluid in Fifty-Two Cases of Congenital Syphilis, J. A. M. A. **76**:12-13 (Jan. 1) 1921.

[15] Jeans: Cerebrospinal Involvement in Hereditary Syphilis, Am. J. Dis. Child. **18**:173. 1919.

[16] Camp, C. D.: The Colloidal Mastic Test on the Cerebrospinal Fluid, Am. J. Syphilis **4**:301-308 (April) 1920.

[17] Stokes and Busman: Am. J. M. Sc. **160**:625 (Nov.) 1920.

[18] Hazen: Syphilis, St. Louis, The C. V. Mosby Co., 1920.

Whether the vicissitudes of war had any effect on the production of syphilis of the central nervous system in syphilitic patients is a question which has been touched on, but on which there is no universality of opinion. Thus, Peghini[19] states that the nervous manifestations of syphilis were more frequent and of greater gravity during the war among the fighting men than in time of peace among this group or in the civilian population. Kahn[20] believes that the war has been without influence on the frequency but that the interval of latency may have been shortened and in some cases the course accelerated. Herzig[21] does not believe that it has had any positive effect. In his institution, prior to the war, about 20 per cent. of the admissions were paretic patients. During the four years of the war only 10.8 per cent. of the admissions were paretic patients. He says that the interval between the infection and the outbreak of the symptoms was the same as that given by Mattauschek and Pilcz for peace time.

Brown and Dujardin,[22] in making a study of herpes zoster, have been struck by the fact that in a large lock department, that is, a clinic dealing with venereal disease, they found that herpes zoster occurred in four cases per thousand as against one case per thousand of ordinary nonsyphilitic cases compiled from general hospital wards. They naturally question whether syphilis acts as a preparation for herpes zoster.

PARTS OF NERVOUS SYSTEM AFFECTED BY SYPHILIS

Würdemann[23] calls attention to neuroretinitis syphilitica and specific inflammation of the optic nerve and contiguous retina frequently associated with papilledema. He considers this due to syphilitic toxins affecting the optic nerve. He states that ophthalmoscopic examination occasionally discloses latent syphilis. He advocates energetic treatment with arsphenamin and mercury and states dogmatically that harm is not done by this treatment. It will be recalled that it has often been stated that it is dangerous to use arsphenamin in the presence of neuroretinitis. It is, therefore, important that an ophthalmologist states dogmatically that such treatment is indicated and is not harmful.

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[19] Peghini: Early Manifestations of Syphilis of the Central Nervous System in Combatants, Riforma med. **48**:1050 (Nov.) 1919.

[20] Kahn: J. de méd. et de chir. prat. **90**:197, 1919.

[21] Herzig: War in Relation to Paresis, Wien. klin. Wchnschr. **32**:1207 (Dec. 11) 1919.

[22] Brown and Dujardin: The Cerebrospinal Fluid in Herpes Zoster and the Relation of Herpes Zoster to Syphilis, Brain **42**:86, 1919.

[23] Würdemann: Syphilitic Neuroretinitis, Am. J. Ophth. **3**:1 (Jan.) 1920.

Of similar import is an article by Davis[24] dealing with the arsenical treatment of syphilitic affections of the acoustic nerve. He states that auditory nerve difficulties arising during arsphenamin treatment are due to the disease and not to the treatment. He says "when properly given we may safely acquit salvarsan of producing neurotropic lesions as neurorecidives." His point of view about the production of arsphenamin neurorecidives is not in accord with that of many authors, and his statement, as that of Würdemann, must be taken as a point of view and not as decisive.

The involvement of the eighth nerve in the secondary period of syphilis is reported by Capelli and Torrigiani.[25] They cite seven cases in which there was a more or less rapid onset of deafness on one or both sides accompanied by dizziness with crises of vertigo. They conclude that the eighth nerve is the cranial nerve most commonly affected in the secondary stage of syphilis. It is often accompanied by neuroretinitis of the facial and oculomotor nerves. The majority of patients improve rapidly under specific treatment but a return to normal is rare.

Goeckermann, Barlow and Stokes[26] studied the eighth nerve in relation to acquired syphilis. The patients were given the ordinary audition tests, the Rinne, Weber and other tests. They conclude that:

> 1. The so-called lowered bone conduction test (reduction in conduction of sound by bone as compared with otherwise normal hearing) is positive in 78 per cent. of known syphilitics in our series.
>
> 3. The efficiency of the test varied greatly in different types of syphilis, being at its best in late cutaneous syphilis (100 per cent.), latent syphilis (80 per cent.), syphilis of the central nervous system (80 per cent.). It had almost no value in osseous lues, and the results in early syphilis were inconclusive (too few cases). A negative Wassermann test combined with a negative bone conduction test is strong evidence of the absence of syphilis.
>
> 4. The test agrees with the positive or negative diagnosis of syphilis in 67 per cent., and disagrees in 33 per cent.
>
> 5. The test was also positive in 48.7 per cent. of patients in whom syphilis could apparently be excluded.
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> 6. It has, on the whole, therefore, only a restricted value as a diagnostic aid, owing to its high factor of error.

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[24] Davis: The Diagnosis and Treatment of Syphilitic Affections of the Acoustic Nerve, with Special Reference to the Use of Salvarsan, The Urol. & Cutan. Rev. **22**:631, 1918.

[25] Capelli and Torrigiani: Nuovo contributo allo studio delle lesioni del nervo acustico nella sifilide recente (Further Contribution to the Study of Lesions of the Acoustic Nerve in Early Syphilis), Gior. ital. d. mal ven. **61**: 243 (Aug. 12) 1920.

[26] Goeckermann, Barlow and Stokes: The Diagnostic Value of Lowered Bone Conduction in Syphilis, Am. J. Syphilis **3**:240-247, 1919.

Schaller[27] has made an important contribution to the pathogenesis of tabes dorsalis. In brief, he states that both cranial nerve involvement and dorsal root degenerations are conditioned by subacute inflammatory changes in the subarchnoid space by:

1. Mechanical effects: (*a*) fibrous constriction of the dorsal roots in Obersteiner's area, (*b*) root pressure from the increased cerebrospinal fluid pressure.

2. Inflammatory: direct extension of meningeal inflammation causing a meningoradiculitis.

3. Toxic: toxic products engendered by meningeal inflammation in the subarachnoid space affecting the dorsal roots. He concludes that the primary change is in the pia-arachnoid.

Gallotti and Azevedo[28] report their experimental work on dogs inoculated with *Trypanosome cruzi.* They found degeneration of the posterior entering roots without involvement of the ganglions or peripheral part of the nerve.

Shmookler and Rubenstone[29] report the finding of active spirochetes in the frontal and parietal region of the brain and in the pons and meninges in a brain removed immediately after death. No organisms were found in the spinal cord or cerebellum. As the brain tissue cooled it was more and more difficult to demonstrate the organisms, and four hours after death it was impossible. It is interesting to note that the organisms were found in the pons as well as in the cortical region.

Rossi[30] calls attention to the brain changes outside of the cortex in general paresis. He states that the cortex in general paralysis of the insane has been the object of more research than subjacent areas of the central nervous system, but in paresis there are numerous clinical symptoms—ataxia, dysarthria, tremor, etc.—for which no cortical pathogenesis is probable. Rossi has found in the medulla of a number of typical cases of the disease primary neuroglial overgrowth of varying degree round the upper end of the central canal, under the floor of the fourth ventricle and around the nuclei of origin of the lower cranial nerves; in particular, throughout the inferior and accessory olives a marked amount of gliosis with hypertrophy of astrocytes is to be noted. Rossi emphasizes the clinical significance both of the subependymal and the olivary gliosis, sometimes amounting to actual nodular glioma formation. From the point of view of the symptomatology of the disease the presence of this process entails a functional disturbance and eventually a degenerative atrophy of bulbar mechanisms; in fact, there is bulbar ataxia as a consequence of impairment of olivo-cerebellar fibers.

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[27] Schaller: The Pathogenesis of Tabes Dorsalis, Arch. Neurol. & Psychiat. **1**:749 (June) 1919.

[28] Gallotti and Azevedo: Contributions to the Study of the Pathogenesis of Tabes, Rev. Neurol. **32**:489, 1919.

[29] Shmookler and Rubenstone: Demonstration of the Spirochaeta pallida in Nerve Tissue by Dark Field Illumination, New York M. J. **110**:107, 1919.

[30] Rossi: Bulbar Neuroglia in General Paralysis and the Significance of Its Occurrence in the Bulbar Olives, Arch. ital. de biol. **69**:55.

TREATMENT OF NEUROSYPHILIS

The literature on the treatment of neurosyphilis is large, and it is impossible to do more than skim over some of the suggestive papers. Gennerich's book is a most elaborate consideration of the effects of treatment on various types of syphilis of the central nervous system. It may be said in general that Gennerich is an ardent advocate of intraspinal therapy for all forms of syphilis of the central nervous system. From France as well as from Germany come reports of satisfactory results obtained in the treatment of neurosyphilis by the intraspinal method. Thus, Ravaut[31] claims good results by the use of the intraspinal method in patients who have not done well on other forms of treatment. Marinesco[32] says, "I have the firm conviction that the treatment of general paresis by salvarsanized serum, in vivo or in vitro, causes the question of the curability of the affections called parasyphilitic and syphilis of the central nervous system to enter into a new phase." Lafora[33] concludes that intraspinal treatment is more efficacious than intravenous in certain cases and that patients with tabes and general paresis as well as with optic atrophy are improved by intraspinal treatment.

Results of Intraspinal Administration of Mercurialized Serum

		Clinical Result		Serologic Result	
	No.	Good	Bad	Good	Bad
Tabes	6	4	2	1 (?)	4 (?)
General paresis	6	2	4	1	5
Taboparesis	2	..	2	..	2
Cerebrospinal syphilis	8	8	..	5	3
Asymptomatic neurosyphilis	3	1	2	..	3
Total	25	15	10	7	17 (?)

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31. Ravaut, Arbeit and Rabeau: Treatment of Neurosyphilis, Paris méd. **10**:353 (Nov. 13) 1920.

32. Marinesco: Intraspinal Treatment of Neurosyphilis, Rev. Neurol. **32**: 901 (Dec.) 1919.

33. Lafora: Traitement intra-rachidien des affections syphilitique et Parasyphilitiques de septime nerveux, Rev. Neurol. **32**:625, 1919.

Keidel and Moore[34] give an interesting summary of their experiences with the use of mercurialized serum given intraspinally. Their conclusions are that intraspinal therapy is a necessary and rational adjunct in the treatment of neurosyphilis in patients who fail to respond to routine antisyphilitic treatment, and that the mode of action of the intraspinal medication does not depend on increased permeability of the meninges, but that the aseptic meningitis produced by intraspinal injections of irritants may prove an untoward rather than a beneficial factor in the treatment of neurosyphilis. Table 1 summarizes their results.

A strong plea for spinal drainage in the treatment of neurosyphilis is made by Dercum.[35] He discusses the circulation of the cerebrospinal fluid in considerable detail. His article is devoted largely to a theoretical discussion and is of great importance. However, we are reminded of John Hunter's famous dictum, "Don't think, try," and feel that Dercum's enthusiasm for this method is premature for the amount of clinical experience with the method of drainage as compared with the result of experience with other methods.

Schroeder and Helweg[36] report nine cases of paresis treated by cranial subdural injections. Their results are not satisfactory.

Skoog and Menninger[37] treated twelve patients suffering from nonparetic neurosyphilis with intraventricular injections. They conclude that the results are encouraging considering the material; but, aside from laboratory improvement, the results reported do not seem satisfactory and no better than could have been expected from the use of arsphenamin intravenously.

Of great interest as offering a new route for the introduction of serum into the central nervous system is the work of Wegeforth, Ayer and Essick.[38] McCusker[39] reports the utilization of this route in the treatment of general paresis without drawing any therapeutic conclusions, but says it is a satisfactory procedure. I can confirm this statement from my own experience. If there is any value in the arsphenamized serum in the treatment of cases of syphilis of the base of the brain this apparently is the route of election for the introduction of the serum. The serum unquestionably reaches the base of the brain as far anterior as the fifth nerve, as symptoms of fifth nerve irritation are immediately noticed when the serum is being introduced.

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[34] Keidel and Moore: Treatment of Neurosyphilis by the Intraspinal Study of a Series of Cases Treated from the Point of View of Increased Permeability of the Meninges, Bull. Johns Hopkins Hosp. **31**:404 (Nov.) 1920.

[35] Dercum, F. X.: The Functions of the Cerebrospinal Fluid, with Special Consideration of Spinal Drainage and of Intraspinal Injections of Arsphenamized Serum, Arch. Neurol. & Psychiat. **3**:230 (March) 1920.

[36] Schroeder and Helweg: New Investigation Into the Treatment of Dementia Paralytica by Subdural Injections of Neosalvarsan, Hospitalstidende **61**:945, 1918.

[37] Skoog and Menninger: The Treatment and Study of Twelve Nonparetic Neurosyphilitics Treated by Intraventricular Injections of Salvarsanized Serum, J. Nerv. & Ment. Dis. **1**:114, 1919.

[38] Wegeforth, Ayer and Essick: The Method of Obtaining Cerebrospinal Fluid by Puncture of the Cisterna Magna (Cistern Puncture), Am. J. M. Sc. **157**:789, 1919.

[39] McCusker: Intracistern Injections of Arsphenamized Serum in Neurosyphilis, Boston M. & S. J. **183**:490 (Oct. 21) 1920.

Neymann and Brush[40] report twenty-four cases of general paresis treated according to their method, that is, weekly intraspinal injections of serum alternating between the arsphenamized and mercurialized serum. Six of the twenty-four patients were reported as markedly improved, five returning to their occupation with the serologic findings practically negative. The average duration of the improvement was fifteen months. Six others were somewhat improved clinically and serologically; six showed no definite improvement, and six were probably made worse.

Sicard[41] advocates the use of small doses of arsphenamin repeated at short intervals for satisfactory results.

Devota[42] cites the case of a patient with tabes who was greatly relieved by the intravenous use of potassium iodid after neo-arsphenamin had failed.

Nonspecific treatment of paresis has been attempted by infecting the patient with the spirochete of relapsing fever as patients with paresis at times improve after an infection with some pathogenic organism. Plaut and Steiner[43] and Mühlens, Weygandt and Kirschbaum[44] have used this method. The latter authors likewise inoculated patients with the malarial plasmodium. The results are not particularly striking, and it does not seem as though this would ever become a practical method. Plaut and Steiner report that of six patients infected with the spirochetes of relapsing fever one had a remission and two were improved.

The two divergent views as to the value of treatment in general paresis are constantly appearing in the literature. Hall,[45] in reviewing the situation, feels that nothing can be done at present to alleviate the paretic patient. On the other hand, Starkey [46] states that paresis is characterized in the beginning by a leptomeningitis which is infiltrative or exudative, and by perivascular infiltration, especially affecting the small vessels rather diffusely distributed through the cortex. Tabes is in the beginning a syringoleptomeningitis. All the symptomatology of syphilis of the central nervous system, either paresis, tabes, or cerebrospinal syphilis, may be present when the disease is still in the leptomeningitic stage, and there is no absolute method of differentiating this exudative nondestructive, curable stage from the later destructive incurable stage.

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[40] Neymann and Brush: Treatment of General Paresis, Arch. Int. Med. **28**:345, 1918.

[41] Sicard: Traitement de la syphilis par les injections novarsenicales à petites doses repetées et prolongés, Presse méd. **28**:281.

[42] Devota: Intravenous Injections of Potassium Iodide in Tabes Dorsalis, Lancet **196**:339, 1919.

[43] Plaut and Steiner: Rekurrensimpfungen bei Paralytikern, Neurol. Centralbl. **38**:727-728, 1919.

[44] Mühlens, Weygandt and Kirschbaum: Die Behandlung der Paralyse mit Malaria und Rekurrenzfiever, München. med. Wchnschr., March 24, 1919, p. 357.

[45] Hall: Paresis, a Look-Back on Recent Therapy, Virginia M. Month. **45**:157, 1918.

A similar point of view is expressed by Ferrand [47] as regards tabes. He states that tabes is a chronic meningomyelitis and that the meningeal reaction can be reduced by treatment, with a resultant improvement of the case.

AUTHOR'S VIEW ON TREATMENT OF NEUROSYPHILIS

The literature quoted shows that there is no uniformity of opinion concerning the value of treatment in the various types of neurosyphilis; it does not show which method is most satisfactory. The majority of reports concerning treatment are unsatisfactory, for, as a rule, few patients were treated, and usually treatment was not carried on arduously or to conform with the patient's tolerance for the drugs. In the majority of instances the patients were not followed for a long period after improvement, a criticism often made by those who hold the opinion that treatment is of little value. However, it seems that good results reported frequently and from different localities are of more significance than the failures reported. Unless the therapist has reported poorly observed or poorly controlled results, it must be accepted that results satisfactory to the patient often have been obtained. My own experience has been that when treatment is carried on intensively over a long period of time, utilizing the various methods when indicated, on the whole rather satisfactory results are obtained.

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46. Starkey: Pathology of Neurosyphilis and Its Relation to Prognosis, The Alienist and Neurologist **2**:119, 1919.

47. Ferrand: Specific Treatment of Tabes, Bull. méd. **34**:960 (Oct. 30) 1920.

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WILHELM ERB
1840-1921

Obituary

WILHELM ERB, 1840-1921

Wilhelm Erb has passed away. Through his death Germany has lost the man who had been to her what Charcot was to France and Gowers to England—her leading neurologist. He had nearly reached his eighty-first birthday; he was born in Winnweiler in the Bayerische Pfalz on Nov. 30, 1840, the son of a forester. To the conditions of his earlier life he probably owed a rugged constitution and his tremendous capacity for work. His enthusiasm for his science, his keen sense of duty and responsibility left him little time for recreation. It is true that every summer he was absent from his post for many weeks, but he usually returned with the manuscript of some important work. He was a man of exceptional energy, who had few personal interests. It was the truth, and the truth only, which counted.

He had a keen sense of humor although life, with many triumphs, had brought him much sorrow. He was gruff to all and prone to lose his temper. His gruffness, the writer felt, was a cloak behind which he hid his tenderheartedness, of which he was ashamed. Those who worked with him and under him know from personal experience, that he never overlooked an opportunity to be of help to them or to do some thoughtful, kind deed.

He began his medical studies at the University of Heidelberg at the age of 19, continued them in Erlangen and received his degree in Munich in 1864. His dissertation was on "Die Pikrinsaeure; ihre physiologischen und therapeutischen Wirklungen." He became assistant to the pathologist Buhl, but remained with him for only a short time. The offer of an assistantship under Friedreich soon brought him back to Heidelberg where he established himself as a teacher in medicine. The title of his Habiliationschrift was "Zur Entwickelungsgeschichte der roten Blutkoerperchen." In 1880, he became professor ordinarius and director of the Medical Policlinic at Leipzig, and, in 1883, professor ordinarius and director of the Medical Clinic at Heidelberg. Here he remained in spite of tempting calls to Bonn, Leipzig, Vienna and Berlin, and it was here that his most important work, which will assure him a place in the memories of many generations of neurologists, originated. His activities as a writer, however, were not limited to this specialty, for nearly one fourth of his 237 publications were devoted to internal medicine.

He was the author of three major works, all of them in their days considered among the best on their particular subject: "Handbuch der

Krankheiten der peripheren cerebrospinalen Nerven," "Handbuch der Krankheiten des Rueckenmarks under verlaengerten Marks" and "Handbuch der Elektrotherapie." A number of monographs of importance issued from his pen: "Klinische, experimentelle und pathologisch-anatomische Begruendung der Entartungsreaction," "Die Thomsensche Krankheit (Myotonia congenita) Dystrophia muscularis progressiva," "Ueber das intermittende Hinken" and "Tabes dorsalis."

Many of his shorter publications were devoted to these same problems, while others dealt with a great variety of topics, both in neurology and in internal medicine. He was one of the founders and editors of the *Deutsche Zeitschrift für Nervenheilkunde* and edited, together with von Bergmann and von Winckel, Volkmann's "Sammlung klinischer Vortraege."

Erb's reputation rests not alone on his many and valuable publications. Great as he was as a clinical investigator, he was even greater as a clinical teacher and diagnostician. He possessed to a degree rarely encountered the faculty of arousing the interest and enthusiasm of his pupils, and therefore not a few of his former students and assistants are counted among the abler neurologists of Germany. It was not easy to work for him. He, who himself would never permit anything to interfere with his duties and his work, expected the same sacrifices from his assistants. He was a stern task-master, feared by all, but also respected and loved.

Patients came to him from all corners of the world. They all received the best that was in Erb, the day-laborer in the public wards of the hospital or the Grand Duke who came to his consulting room from Petrograd. Among his private patients he was known as "Der grosse Zauberer."

If Erb looked back in his declining years on a career which had brought him much fame and many honors, he had also to look back on many sorrows. Three of his four sons had died before him, as had his first wife. The desperate straits in which his native country found itself during the last year deeply affected him. And still the end came beautifully. He was at a concert, listening to the notes of a composition which was his favorite, the "Eroica," when an attack of syncope overcame him which gradually merged into a calm and peaceful end.

Sydney Kuh.

Abstracts from Current Literature

AN UNUSUAL PONTILE SYNDROME. Hubert Sieben, Med. Klin. **17:** 996 (Aug. 14) 1921.

The author describes an unusual and interesting case of pontile disturbance in a woman, aged 48. The past history was negative except for the presence of sugar (1.5 to 3 per cent.) in the urine for several years. When first examined, Nov. 16, 1920, the patient gave a history of having felt fatigued and restless for several days. On November 12 she fell, bruising the left side of her head. By the sixteenth the head injury had apparently recovered. The day following the injury the patient had frequent spasms in the left hand and cramps in the thumb. The following day the same symptoms were noted but to a less degree. On the fifteenth she had a rather severe cramp-like attack, and it seemed to her as if a line had been drawn across her head with a steel pencil. This was followed by a severe convulsion lasting about one minute. Convulsions then recurred every five minutes, coming on suddenly without aura. The head was pulled to the left and the entire facial musculature was in tonic contraction. During the attack the pupils seemed small, but the reaction to light could not be determined. The eyeballs were rotated up and to the left. Between atacks she was mentally clear. The pupils reacted normally. The left side of the body was also involved in the severe attacks. The leg became strongly extended, and the arm was either strongly extended with the hand pronated or the arm was flexed at the elbow with the hand supinated. At no time were tonic spasms noted. During the attack consciousness was markedly obtunded or lost. During the course of several days both the left arm and leg became paralyzed and hypesthetic, with a positive Babinski sign. The attacks continued day and night, the left side being involved in the tonic spasms even after the occurrence of paralysis. The temperature varied between 37 and 38 C. (98.6 and 100.4 F.). Lumbar puncture was impossible. The right side of the body, except the face, was not involved, and during the interval period the patient could move the right limb voluntarily. Bromids had no effect on the spasms.

The condition at first was thought to be cortical. In the course of a few days bulbar symptoms occurred. There was difficulty in swallowing, disturbance in phonation and articulation. Rapidly paralysis of deglutition occurred, chewing became impossible on either side, though the lower jaw could be moved. The face appeared mask-like, due to bilateral facial palsy. The facial muscles could, however, be moved slightly. There was no paresis of the third or fourth cranial nerves. Throughout consciousness remained clear between attacks. There was no involvement of the bladder or rectum. The urine showed the former percentage of sugar. There was no acetone. The condition continued for three or four days when a gradual improvement set in. Deglutition became possible, the attacks more infrequent, having continued for six days, day and night, every five minutes. The remaining bulbar symptoms regressed. The attacks became less, the last one occurring Dec. 6, 1920. Three weeks later the patient had a severe grip from which she made an uneventful recovery.

With the appearance of the bulbar symptoms the possibility of a cortical lesion had to be abandoned in favor of a pontile lesion. With the exception of the pyramidal and sensory disturbance, the lesion seemed to be thalamic in origin with disturbance of deglutition, phonation and articulation.

The author calls attention to the oral disturbance noted in this patient closely resembling that recently noted by Fisher. (Fisher: Isolated Loss of Mimic, Phonation, Articulation, Mastication and Deglutition, with Retention of Voluntary Innervation or the Oral Muscle Complexes, *Med. Klin.*, Jan. 2, 1921.) Fisher maintained that there exists an oral muscle complex which may be singled out, and Sieben believes that his case bears this out.

The author believes that one may assume a hemorrhage in the pons due to injury. This must necessarily have been small or death would have ensued. Such lesions frequently result in unilateral convulsions, more rarely in bilateral. Nothnagel assumes a center in the pons which has to do with cramps; others, however, deny the existence of such a center. Nevertheless, it is maintained that lesions of the pons may cause convulsions. The irritation of pontile vasomotor centers has been looked on as the cause of convulsions, and Oppenheim states that Luce has attributed epileptiform qualities to the motor nuclei of the pons, and does not deny that reflexly convulsions may occur in pontile lesions.

In the present case it is assumed that the convulsions may be attributed to a pontile lesion. The fleeting duration of the entire picture tends to this diagnosis. The author believes a softening is excluded. Hysteria may be ruled out because of the Babinski and bulbar symptoms. He does not believe that diabetes played any part in the present illness. The remaining cause considered is encephalitis. In Fisher's report encephalitis was considered as the etiologic factor. At the time of the patient's illness there was no epidemic prevalent. However, sporadic cases of encephalitis were occurring, and two deaths had resulted.

The author again directs attention to the frequency with which the pons is selected in encephalitis. Whether this case could truly be ascribed to encephalitis or not remains a question.

In conclusion the author discusses the relation of grip to encephalitis.

Moersch, Rochester, Minn.

ATYPICAL FORMS OF EPIDEMIC ENCEPHALITIS. Charles Rosenheck and Leon H. Cornwall, Neurol. Bull. **3**:259 (July) 1921.

The authors call attention to the frequency of atypical epidemic encephalitis and present six instances.

Case 1.—A man, aged 58, was stricken suddenly while attempting to mount a flight of steps, but did not lose consciousness. Examination disclosed paresis of the right leg, ankle clonus, a Babinski sign, hyperactive deep leg reflexes on both sides and tenderness in the affected extremity.

Case 2.—An attorney, aged 48, developed a depression with insomnia and anorexia following financial reverses. Three weeks later, there abruptly appeared neuralgic pains in the left arm and ipsolateral sciatic distribution. The patient had no fever. Pupillary anomalies led to a series of arsphenamin treatments which were followed by intensification of the pain and a mental syphilitic complex. Neurologically, there were deep hyperreflexia, diffuse muscular tenderness, a slightly irregular, unequal pupil with delayed light reaction.

Case 3.—A married woman, aged 30, suddenly complained of a burning sensation in the lumbar area with darting bilateral sciatic pains. Subjectively, there were irritable apprehension, scalp pains and fatigue; objectively transient fever, insomnia, muscular tenderness, lumbosacral hyperesthesia and plus deep reflexes.

Case 4.—A salesman, aged 54, developed sacro-iliac pain radiating down the outer aspect of the left thigh and leg. In three days this was replaced by a dull ache in the upper third of the outer aspect of the leg. There was no fever. The left patellar reflex was absent and the abdominal reflexes were weak.

Case 5.—A married woman, aged 30, was nervous, apprehensive, and emotionally unstable for seven months following marital trouble. She had lancinating pains in the extremities, chest and lower spine. There was no fever. After three months examination revealed generalized muscular tenderness, segmental hyperesthesia and irregular pupils, one reacting sluggishly.

Case 6.—A business man, aged 38, had a nonconfining illness marked by lassitude, irritability, loss of weight and apathy in July, 1919. In April, 1920, these symptoms recurred with added mental anxiety and hyperthyroid manifestations. Discovery of tooth infection led to radical dental surgery followed by a two months' improvement. In August, 1920, sudden headache, gastrointestinal disturbance, scalp pain and a twelve day fever averaging 100 F. appeared. Improvement was succeeded in January, 1921, by the "onset of abdominal discomfort with eructation of gas after meals, intestinal distention, obstinate constipation, soreness and deep-seated dull pain in the lumbar and abdominal muscles, frequent micturition and pain in the scalp. The temperature averaged from 99 to 100.3 F., with a few remissions for one month, and anorexia became extreme." Neurologically there were hyperactive deep reflexes, a bilateral Babinski sign and left homonymous optic disk pallor.

Clinically, the authors comment on the fact that all but one of the patients were ambulant, and that two of the six exhibited abnormal pupillary phenomena suggesting neurosyphilis. They further call attention to the following clinical variants: "Insomnia, emotional instability, absent or very slight rise in temperature, the predominance of purely spinal phenomena, such as intermittent, dull, boring pain of a vague, shifting character, muscular sensitiveness, scalp pain, bladder disturbances, plegias and alterations in reflex behavior."

A summary of the serologic findings shows that the fluid pressure was considerably increased in two instances; there were 18, 25, 12, 15, 22 and 185 cells, respectively; the globulin test was + + in Cases 1 and 6; sugar reduction was increased in four cases, strikingly so in Case 2; the Wassermann reaction was always negative with 2 c.c. of fluid, and there were the following gold curves: 0111200000, 0112210000, 0011110000, 0121110000, 2222345321. There was no reaction in Case 4.

The authors regard all the cell counts as abnormal. In Case 6 there were 34 per cent. neutrophils, and Cornwall is of the opinion that the number of these cells is higher in encephalitis than in anterior poliomyelitis. Much diagnostic stress is given to the sugar increase. The gold curves are interpreted as being in favor of encephalitis.

Neurologists should be particularly interested in case reports of atypical encephalitis, because at this time a great number of rather vague and undifferentiated neuropsychiatric syndromes are being presented in clinic practice as suspected cases. In a disease such as encephalitis, which has such a protean clinical expression, there is always danger of it being made too inclusive. It is possible that puzzling clinical pictures may in this way escape exhaustive study. The authors have carefully investigated their cases and presented justifiable tentative diagnoses, but not necessarily final ones. The experience of Solomon and others shows that it is sometimes fallible to exclude neurosyphilis on the basis of the serologic findings. There is no blood serum Wassermann reaction recorded for Case 1; in Case 2 the fluid was negative, but after a course of arsphenamin medication; Case 3 hardly justifies a conclusive opinion either from the clinical or from the serologic standpoints.

Strecker, Philadelphia.

THE NATURE OF SO-CALLED IDIOPATHIC EPILEPSY ACCORDING TO RECENT STUDIES. P. Pagniez, Presse méd. **29**:582 (July 23) 1921.

This is a comprehensive and interesting review of various current conceptions of the epilepsies, and of the progress that has been made along different lines, especially in investigating the mechanism of traumatic cases and in experimenting with protein therapies.

The conceptions of idiopathic epilepsy formulated a number of years ago are still current. Epilepsy is probably the resultant of two factors: (1) a congenital or acquired lesion of the nervous system which constitutes a predisposition; (2) an intoxication, generally alimentary, that constitutes the precipitating cause of the paroxysm. The brain lesion assumed to antedate the initial attack is probably residual from a local injury which may have been traumatic but which is oftener infectious or toxic.

French observers working over the war material found that partial or general epileptic seizures supervened in from 10 to 20 per cent. of serial cases of cranial injuries. The greatest incidence was seen in the series longest observed. These attacks appeared after a latent period, of from three to five months usually, or from five to ten months (in one fifth of the cases). Jacksonian was more frequent than general epilepsy. The form of the scar tissue, not the destructive lesion itself, seems to be responsible, as shown by the fact that the more scar tissue there is, the greater the risk of epilepsy. The long latent period before attacks corresponds to the cicatrization of the lesion.

Some vasomotor disorder at the cortical level, whether anemia or stasis, occasions the crisis of grand or petit mal. Anemia itself must be sufficient, because in certain cardiac cases the suppression of systole causes these symptoms: for three seconds, vertigo; seven to eight seconds, fainting; twelve to fifteen seconds, epileptiform convulsions. Leriche is quoted as having actually observed anemic phenomena in the exposed brains of two subjects with cranial injuries. Another observer found each convulsion preceded by spasm of the retinal arteries which began ten or twenty seconds before the convulsion and persisted throughout in cases of status epilepticus.

Alimentary intoxication is still conceded to be the most important precipitating factor in idiopathic cases. The accumulation of normal waste products sometimes plays a part, as also does polyglandular insufficiency. "Colloidoclastic shock" (choc colloidoclasique of Widal et al.) may be involved. Pagniez does not believe that the epileptic seizure is an example of pure anaphylactic crisis; the stereotyped manifestations of the former cannot be identified with the varied phenomena of the latter.

Of the protein therapy experiments reported, one of the most notable was that of Edgeworth who claimed a complete symptomatic cure in 40 per cent. of a short series. These subjects received small doses of peptone intravenously. Autoserotherapy has been unsuccessful.

Huddleson, New York.

FEVER REACTION IN PATIENTS WITH MENTAL DISEASE FOLLOWING INTRAVENOUS INJECTIONS. W. Jacobi, Ztschr. f. d. ges. Neurol. u. Psychiat. **24**:89 (July 10) 1921.

Four catatonic patients were given 250 c.c. of Ringer's solution by intravenous injection. The rise of temperature in one case lasted seventy-two hours. Repetition of the injection three days later (subcutaneously) brought about collapse in one of the patients.

Fifty patients were each given 50 c.c. of Ringer's solution intravenously. Twelve of fourteen patients, whose condition had been diagnosed as hebephrenia, reacted with fever of 38 to 40 C. (100.4 to 104 F.); four catatonic patients had high fever; patients with paranoid dementia praecox gave but slight reaction. Of fifteen hysterical patients only one reacted to 38 C. (100.4 F.). In eight manic patients the temperature rise was less than one degree. In four patients with presenile depressions, including two who had arteriosclerosis, the fever ranged from 38.3 to 39.2 C. (100.9 to 102.5 F.). The schizophrenic patients reached the maximum fever point in from four to five hours. As a fever accompaniment there was a neutrophilic leukocytosis and eosinophilia. Although Ringer's solution produces cell injury, fever is less often effected than by physiologic sodium chlorid solution. This is explained by the theory that the addition of calcium and potassium to the cells prevents their substitution through the sodium-ion, and thus chemical irritation of the heat producing centers resulting in albumin destruction is avoided. The blood platelets and cells are particularly sensitive. Salt-free Ringer's solution produces only a mild temperature rise, but abdominal infusion of salt solution gives definite fever. Inhibition of heat-producing centers by means of large doses of morphin and hydrated chloral prevented the febrile manifestation following injection of Ringer's solution. Therefore, the explanation of the fever of schizophrenic patients solely on the basis of increased reactivity of the sympathetic thermogenetic center seems unlikely because outspoken vagatonia is demonstrable in praecox and excited catatonic states. As a contrast we may consider the high tolerance for carbon hydrate, marked epinephrin glycosuria, and diacetic and acetonuria. On the other hand, we find a sympatheticotonic picture in involution melancholia. The author's conclusion is that in the course of dementia praecox certain peculiar substances foreign to the plasma are formed, which are injured through the kation sodium, and that the products of degeneration act as irritants to the temperature regulating centers.

Strecker, Philadelphia.

LESIONS OF THE BRACHIAL PLEXUS ASSOCIATED WITH RUDIMENTARY RIBS. Percy Sargent, Brain **44** (July) 1921.

Sargent quotes from the literature on the subject and mentions investigations which show that there are distinct relationships between the presence of cervical ribs, anomalies of the first thoracic ribs and the structure of the brachial plexus. Not only do anomalous ribs cause changes in the structure and relationships of the brachial plexus, but also in the cervical and sympathetic nerves and the vessels of the neck, giving rise, more frequently than is suspected, to painful disturbances.

Symptoms due to cervical ribs are usually brought on by trauma and strain when sudden in onset; by continued friction of the nerves against the ribs or the "nonossified costal process" from respiratory movements, when gradual in onset. The fibrous band which exists between the anomalous rib and the first thoracic rib causes an acute angulation of the lower cord of the plexus and on inspiratory movement is pulled taut. Cervical ribs are usually bilateral, but the symptoms are invariably worse on one side than the other.

The symptoms are pain, paresthesiae, disorders of circulation, sensory disturbances in the cutaneous areas, weakness, wasting of tissue and altered electric reactions—depending on whether afferent, efferent or sympathetic nerves are involved. S. Kinnier Wilson is quoted as calling attention to a characteristic peculiarity in muscular wasting—namely, a picking out of the abductor brevis and opponens pollicis (seventh cervical) to the exclusion of other thenar muscles (eighth cervical). In thirty-two cases of the author's series, the sixth, seventh and eighth cervical and first thoracic nerve were involved in six cases, the seventh and eighth cervical and first thoracic in fourteen, and the seventh and eighth cervical in twelve. The seventh and eighth cervicals, as is seen, were affected in all.

Sensory alterations were present in 40 per cent. of the cases. The anatomic arrangement found in most of these cases was that of an absent first thoracic nerve with the eighth cervical supplying the area. Not all cases are due to cervical ribs. There are occasionally found large nerves from the first thoracic which pass over the first rib and become subjected to stretching and irritation.

As to treatment, operation offers the most hopeful results. Following Stiles, the author believes that removal of the cervical rib, any fibrous bands and sometimes a portion of the first thoracic rib is required. Other treatment consists in greater use of the opposite arm, carrying the affected arm in a sling, massage, muscle training and change of occupation.

The author was able to follow twenty-seven of his operative cases and found that nineteen of these patients were cured of pain and the rest considerably relieved. Usually the relief of pain and other symptoms is immediate, but when it is not, there is some question of incomplete removal of the underlying factor. Some patients whose recovery is apparently delayed recover after a more extended time.

Patten, Philadelphia.

THE AFTER-EFFECTS OF EPIDEMIC ENCEPHALITIS IN CHILDREN. D. Paterson and J. C. Spence, Lancet **2**:491 (Sept. 3) 1921.

These authors summarize the after-effects in twenty-five cases of lethargic encephalitis occurring in children from 3 months to 11 years of age. The diagnosis in each case was made only after examination of the cerebrospinal fluid and a careful study of the ultimate course of the disease. Their cases were all physically and mentally normal prior to the onset of the encephalitis. One child, aged 21 months, died on the seventh day of illness, the diagnosis being confirmed at necropsy. Five cases are recorded in which the patients recovered completely, one in which the patient was mentally normal with slight ataxia one year after the onset. Seven cases resulted in permanent and hopeless idiocy. Two of these seven patients had spastic diplegia with "scissor legs" and contractures, and one, rigidity of the extremities with purposeless movements. In eleven cases minor degrees of mental deficiency (imbeciles in the usual meaning of the term) are reported. One patient, one year after the onset, now 8 years of age, presents a paralysis agitans syndrome; another, three years after a five weeks' illness has been convicted of theft on several occasions and is considered an incorrigible thief; three are attending special schools for mentally defective children. The effects of lethargic encephalitis in infants and young children are much more serious than in older children. Of those affected before the age of 12 months only one has made a complete recovery and four are considered idiots. The after-effects of encephalitis appear to be in direct proportion to the severity of the initial attack. Some degree of mental deficiency may be expected from the illness if the stupor and lethargy persist for three or four weeks in a young child. If, on the other hand, the illness is brief, with stupor for a few days only, complete recovery will probably result. The younger the child at the onset of the disease and the longer the acute phase of the illness, the greater will be the degree of the mental deficiency which follows it. The physical results from encephalitis in childhood may include spastic diplegia, hemiplegia, symptomatic paralysis agitans, muscular rigidity and tremors.

Potter, Mercer, Pa.

PATHOGENIC NOTES ON GENERAL PARALYSIS. L. Marchand, Presse méd. **29**:695 (Aug. 31) 1921.

This is an attempt to show that general paralysis of the insane, according to the accumulated evidence at hand, is probably not due to syphilis but to some unknown agent, perhaps a filtrable virus. The spirochete of syphilis in the brain of a person with general paresis may be an associated or secondary infection.

Marchand emphasizes meningeal lesions and considers them of primary importance. A primary parenchymatous encephalitis with secondary and delayed meningitis, having an irritative origin from the proximity of nervous lesions, may be disputed. Postulating meningitis as primary, the author concludes that since the spirochete has been found only in the gray matter of paretic brains and never in the cerebrospinal fluid, pia mater, or vascular walls, it cannot reasonably be considered the sole cause of general paralysis. He admits that some cases must have a complication of syphilitic meningitis and general paralysis.

Arguments are also adduced against accepting positive Wassermann reactions as conclusive proof of syphilis, both on account of the greater number of positive reactions to sensitized antigens and because of the (alleged) appearance of positive Wassermann reactions in nonsyphilitic subjects after intravenous injections of arsenic preparations, due to a liberation of hepatic lipoids.

Huddleson, New York.

THE USE OF LUMINAL SODIUM IN EPILEPSY. J. T. Fox, Lancet **2**:558 (Sept. 10) 1921.

The author does not claim that sodium phenolbarbital is a curative drug in epilepsy, but he does believe that it lessens the frequency of the convulsive seizures. The report summarizes the results of the administration of the drug to sixteen persons with ordinary epilepsy who were subject to major attacks at fairly regular intervals, but gave no signs of mental defect or deterioration. Most of the patients were taking bromid when the phenolbarbital administration was started, and the drug was continued, as the author felt that deprivation of the bromid would alter incidence of the seizures. The sodium phenolbarbital was given in 1 and 2 grain doses daily, usually at bedtime. The convulsive seizures were reduced in number in every case. During the three months period these patients, with one exception, gained from 1 to 10 pounds each. In five cases the general mental condition remained stationary, four were more cheerful and alert. Three of the sixteen, however, became more irritable than formerly; one girl of 15 years, who gained only 1 pound in three months and in whom the average incidence of seizures was reduced less than one per month, became dull mentally and showed an aphasia; two boys aged 13 and 11 years, respectively, became dull and stupid under the usual dosage, but improved when the dose was reduced. As with other drugs used in epilepsy, phenolbarbital sodium seems to give better results in cases subject to major attacks.

Potter, Mercer, Pa.

THE EXTENT OF SYPHILIS AND THE WASSERMANN REACTION —SYPHILITIC CHARACTER OF "IDIOPATHIC" EPILEPSY.

E. Leredde, Presse méd. **29**:949 (Nov. 30) 1921.

This is a consideration of the claims of syphilis to an etiologic status in idiopathic epilepsy. The writer believes that their occurrence together is no coincidence, but that the epileptic syndrome is often directly referable to syphilis, sometimes acquired but generally hereditary.

He accepts second-generation heredity, considering the acquired syphilis of a patient's grandparent responsible for the former's "idiopathic" epilepsy in an illustrative case. Negative blood Wassermann reactions are disregarded, and clinical points are emphasized. Fourteen typical epileptic cases are tabulated, and it is claimed that the evidence for syphilis is conclusive in at least six. For the rest, syphilis is as reasonable a cause as any other. Results of antisyphilitic treatment are noted.

The article is valuable for calling attention to the not uncommon neurologic error of stressing negative blood and fluid findings. It also suggests that there is more syphilis in chronic affections than is generally recognized.

Huddleson, New York.

THE SIGNIFICANCE OF SOME EARLY SYMPTOMS OF NERVOUS DISEASE.

J. S. Bury, Lancet **2**:549 (Sept. 10) 1921.

Bury calls attention to the significance of pain, numbness, motor disability and the plantar reflex in the early diagnosis of nervous diseases. In his opinion, medical men do not give adequate consideration to the analysis of subjective symptoms; for example, constant headache, made worse by noise or movement, may be an early symptom of brain tumor; temporary numbness may precede a hemiplegia or the onset of disseminated sclerosis; weakness of muscle groups may indicate the beginning of multiple sclerosis, and a transient plantar extension reflex or ankle clonus may precede the characteristic symptoms of disseminated sclerosis by months or years. He believes we should never make a diagnosis of hysteria without a careful consideration of the future developments in the case.

Potter, Mercer, Pa.

CHRONIC PROGRESSIVE EXTERNAL OPHTHALMOPLEGIA.

F. Terrien, Presse méd. **29**:937 (Nov. 26) 1921.

This disease is considered congenital and of unknown etiology. Though typically limited to the extrinsic eye muscles, it is possibly in some cases the precursor of more widespread central nervous affections, such as tabes, multiple sclerosis, bulbar palsy, progressive muscular atrophy or chronic anterior poliomyelitis.

Onset should be observed between the ages of 6 and 10, but three cases out of a series of thirty-four appeared between the ages of 30 and 60. Ptosis is usually the first symptom and generally remains moderate until after the eyeballs have become quite immobile during the slow progress of the disease. Diplopia is not experienced. Both eyes are always affected, not necessarily to the same extent. Visual acuity and eyegrounds are normal, the Wassermann reaction negative, and (in cases in which the diagnosis is unquestioned) the nervous system is otherwise intact.

Huddleson, New York.

REFLEX EPILEPSY. Erich Rosenhain, Ztschr. f. d. ges. Neurol. u. Psychol. **64**:99, 1921.

According to Rosenhain, the concept of reflex epilepsy arose on experimental grounds, Brown-Séquard being the founder of the doctrine. In the early days many cases with hysterical seizures were considered to be of this nature. The rare cases that are reported at present will not stand close scrutiny. On the one hand, they do not show the symptoms which are supposed to be characteristic of reflex epilepsy, and, on the other, they do not correspond to the character of the lesion at fault. "Thus reflex epilepsy is being consigned to the land of the shadows. May this contribution assist in digging its grave."

One interesting case is mentioned in which, on account of injury, the fourth finger had to be amputated. Later, epileptic attacks came on which always began in the stump of this finger and went on to involve the arm, face, and the whole of the left side of the body. With a diagnosis of reflex epilepsy the scar was excised, but without relieving the symptoms. At necropsy a large tumor of the right precentral cortex was discovered.

Freeman, Philadelphia.

TONUS AND MOTOR FUNCTION IN OCULOMOTOR DISTURBANCES. A. Litvak, Rev. Neurol. **27**:331 (April) 1920.

Litvak distinguishes between lid ptosis due merely to hypotonus of the ocular musculature and that dependent on actual paralysis or paresis of the controlling nervous mechanisms, directing especial attention to the fact that the former, particularly if well marked, is practically pathognomonic of syphilitic disturbance. In such hypotonic cases, it will be found that even in complete drop (static) the lid may be voluntarily raised and, if unilateral, the affected lid may be made to exhibit a functional activity equal to that of the sound side; in other words, in hypotonia the disturbance is purely static, while in paralytic states it is both static and dynamic. The author comments on the relatively frequent association of such hypotonic states and ipsolateral optic atrophy, speculating on its significance in point of direct causal relationship.

Raphael, Ann Arbor, Mich.

PSYCHOGENIC LIMPING IN POST-EPILEPTIC TRANCE. Erich Rosenhain, Ztschr. f. d. ges. Neurol. u. Psychol. **64**:96, 1921.

Rosenhain describes the case of a soldier wounded in the face, who was unconscious for three days, and who on being taken back to the hospital had a typical epileptic convulsion. On recovery from the convulsion the patient remained in a trance for the rest of the day. He was fully disoriented, his face was blank, he could hardly answer any questions, spoke explosively, had perseveration of movements and spent hours limping around the room.

Next morning when he had recovered he could walk perfectly well, and had no memory of limping the day before. On going into his history it was found that four years previously, following a wound of the leg, he had limped for several weeks.

The author concludes that this is a manifestation of the hypersuggestibility seen also in many of the psychoses, sometimes in brain tumors, and after attempts at suicide—whenever there is a disturbance of the normal balance of consciousness.

Freeman, Philadelphia.

THE CURABILITY OF TUBERCULOUS MENINGITIS. **Francis Harbitz**, Am. J. M. Sc. **161**:212, 1921.

This author commences his article by laying emphasis on the many examples of cured tuberculosis. Infection of lymph glands, bones, joints and skin go on to arrest and cure. Pulmonary tuberculosis certainly does the same. This is also true of infection of the genito-urinary tract. Infection of serous membranes, such as the pleura and peritoneum, may be arrested and "cured."

In a discussion of tuberculous meningitis, the author cites about forty cases, cured or arrested. He recalls the cases of pseudotumor which Oppenheim thought were tuberculous meningoencephalitis.

Barth, in 1894, described the case of a patient who had had tuberculous meningitis twenty-five years before and who recovered. He died of pulmonary tuberculosis and showed, at necropsy, signs of old leptomeningitis. A number of similar examples are given, including one by the author. He concludes that tuberculous meningitis, particularly in those over 2 years of age, may be cured.

Kraus, New York.

A METHOD OF DETERMINING THE EARLY REGENERATION OF NERVE FIBERS AT OPERATION. **Julius Y. Malone**, Arch. Surg. **3**:634 (Nov.) 1921.

As Malone states, we have had no way of determining whether or not axis cylinders are passing through an injured portion of a nerve except by stimulating the nerve trunk central to the lesion and noting whether this is followed by contraction of the muscles innervated by that nerve. Making use of the fact that when a peripheral nerve is stimulated by the application of cold to the skin in human beings or by direct stimulation of the trunk in animals there is a reflex stimulation of the respiration, blood pressure and reflex contraction of muscles innervated by nerves other than the one stimulated, he offers a new method of accomplishing this result. An electrode is used, carrying a "threshold" current (one sufficiently strong only to stimulate the respiration) and is applied 1.5 or 2 cm. distal to the injured portion of the nerve. He states that by using this test much time can be saved by exploring the nerve in question, if in doubt, as in dogs reflex contraction of the muscle was noted as early as five weeks after suture. This suggestion seems a good one and certainly should be tried.

Rodman, Philadelphia.

THE CAUSE OF SO-CALLED IDIOPATHIC HYDROCEPHALUS. **Walter E. Dandy**, Johns Hopkins Bull., No. 361, March, 1921, p. 67.

The author divides obstructive hydrocephalus into two groups: one in which the aqueduct of Sylvius and the foramina of Lushka and Magendie are closed, the other, which he designates as the communicating type, in which the obstruction lies in the cisterns or in their main branches. The latter type produces the hydrocephalus by preventing the fluid in the ventricles from passing from them to the subarachnoid spaces. The majority of cases of communicating hydrocephalus are sequelae of meningitis. More rarely congenital failure of development of the cisterns or their branches, or tumors, may produce the same end-result. The proof of the existence of these basilar obstructions has been obtained by the injection of air into the ventricles (ventriculography), as well as by the injection of India ink postmortem. The same results have been obtained experimentally by artificial destruction of the patency of the mesencephalic cistern.

Kraus, New York.

ORIGIN OF HALLUCINATIONS. Heinrich Beckel, Monatschr. f. Psychiat. u. Neurol. **48**:407 (Dec.) 1920.

According to the author, hallucinations depend on two factors: first, a general disposition or tendency—the fundamental groundwork on which hallucinations develop; and second, certain exciting factors which act as the immediate cause of the outbreak. The "disposition" is dependent on an absolute or a relative hyperirritability of the cortex, or more properly, on the cortical sense centers. According to type, they may be separated into associative and dissociative hallucinations. The "disposition" for the occurrence of associative hallucinations consists in an increased irritation or increased irritability of the whole cortex. This is found most typically in the toxic psychoses but also occurs under certain conditions in the psychopathic constitution. The disposition to the occurrence of dissociated hallucinations is found in sleep, in the dream-states (Dämmer zuständen) and in schizophrenia, because in these states the normal conscious control is lost. The loss of this higher conscious control leads to a partial dissociation of cortical functions and allows some of the lower psychic and cortical functions to assume an increased, independent activity. This increased independent activity of the sense centers furnishes the disposition or groundwork on which hallucinations form. In the presence of an appropriate disposition certain exciting factors must act to produce the hallucinations. These exciting factors may come from the intellectual sphere, through feelings and emotions, from the sensory sphere, through sensory stimuli, or from impulses arising in the subconscious.

Selling, Portland, Ore.

DIAGNOSIS OF MULTIPLE SCLEROSIS. Julius Schuster, Ztschr. f. d. ges. Neurol. u. Psychol. **65**:1, 1921.

Schuster describes the finding of very large multiple lesions in the brain. In these, by means of Jahnel's method of silver impregnation, he was able to find numerous spirochetes. According to the photographs they are undoubtedly spirochetes, but there is more than a suspicion that Schuster's case was one of juvenile paresis. The patient had delusions of grandeur, dementia, ptosis and a positive Wassermann reaction in the blood and spinal fluid, together with intention tremor and speech defect. Pupillary reactions were normal, and nystagmus was doubtful. When there is so much argument about the finding of spirochetes in multiple sclerosis, it would be unwise to accept any case in which syphilis was a complicating factor.

Freeman, Philadelphia.

NOTES ON MY PUPILLARY PHENOMENON. Emil Redlich, Monatschr. f. Neurol u. Psychiat. **49**:1 (Jan.) 1921.

In 1908 the author described a pupillary phenomenon which he had found in some cases of hysteria and in some cases of epilepsy. The reaction consists of a dilatation of the pupil, accompanied by a reduction or even loss of the light reaction. The test is carried out as follows: The patient is seated, with head tipped well back. The hands are crossed and grasp those of an assistant. Firm, continued pressure of the hands is essential. The normal person shows a little pupillary dilatation with no essential change in the light reaction.

Subsequent investigations have confirmed these results. The author finds that it is chiefly in sympathicotonic persons that positive tests are obtained. He believes that the mechanism of the positive test is based, at least in part, on stimulation of the sympathetic (dilator) fibers.

Selling, Portland, Ore.

News and Comment

DR. MILLS HONORED

Dr. Charles K. Mills of Philadelphia was elected an honorary member of the Dutch Society of Psychiatry and Neurology, at the time of the celebration of its Fiftieth Anniversary in Amsterdam, on Nov. 17, 1921.

Society Transactions

AMERICAN NEUROLOGICAL ASSOCIATION

Forty-Seventh Annual Meeting, June 13-15, 1921, Atlantic City, N. J.

Sidney I. Schwab, M.D., *President*

DISTORTIONS OF THE VISUAL FIELDS IN CASES OF BRAIN TUMOR. (SIXTH PAPER.) THE FIELD DEFECTS PRODUCED BY TEMPORARY LOBE LESIONS. Presented by Dr. Harvey Cushing, Boston.

1. The temporal lobe is a common seat of cerebral tumor (fifty-nine cases in a series of 276 verified supratentorial tumors).

2. In the fifty-nine verified temporal lobe tumors, perimetry, owing to the advanced stage of the process, was precluded in twenty cases, but of the remaining thirty-nine, homonymous field defects indicating involvement of the temporal loop of the optic radiation were present in thirty-three instances.

3. Heretofore the most important symptom for temporal lobe localization has been the occurrence of the so-called uncinate fits, but in this series, even including as such all attacks of petit mal without gustatory impression, they have been recorded in only twenty-four cases.

4. Visual hallucinations have been a frequent symptom of the temporal tumors in this series (thirteen out of fifty-nine cases).

5. Auditory phenomena as recorded in this series are conspicuous by their absence. In only a few cases has there been tinnitus and rarely some lowering of sound perception.

6. The chief errors of diagnosis arise (1) when, with a total median hemianopsia, the occipital lobe is considered to be the tumor seat, (2) in the absence of demonstrable field defects, when symptoms supposedly of cerebellar origin are to the fore.

Hence it is fair to conclude that perimetry gives us information of paramount diagnostic value, particularly in the early recognition of temporal lobe tumors, the partial field defects short of hemianopsia being especially characteristic of involvement of the optic radiation in this region.

DISCUSSION

Dr. Foster Kennedy, of New York, said that about ten years ago, Dr. Cushing invited him to Johns Hopkins to discuss a series of temporal tumors which he had studied rather carefully. In none of that series had he found defect in the visual fields, of which Dr. Meyer had spoken. He did not know then of the existence of "Meyer's loop" and had made careful perimetric tracing in only five cases. After Dr. Meyer had pointed out his deficiency, he had been able in New York to verify the discoveries of Dr. Cushing and believed that was a valuable procedure in the diagnosis of temporal growths. Having asked permission to revert to a previous discussion germane to this paper, Dr. Kennedy spoke of Dr. Cushing's inability to find hearing defect in cases of temporal lobe tumors. This had also been the experience of the speaker, and its explanation lay in the bifurcation of the auditory fibers uniting each auditory nerve to both hemispheres. He was surprised that Dr. Cushing had not been prepared to find subjective visual phenomena in cases of temporal tumor, as it had long been known that this is the one brain area, disease of which can cause complexly constructed visual hallucinations. Hughlings Jackson long ago pointed out this phenomenon. In his cases the spectres were constant for each individual, and the same had been true in the speaker's experience.

Dr. Kennedy thought it of value to speculate on why hallucinations of such extraordinary complexity should occur through irritation of this one area only. Irritation of the occipital lobes produces subjective visual phenomena, but of a very crude gross character. From occipital lobe lesions one obtains colorful, spectroscopic appearances, but from irritation of the temporosphenoidal lobes are produced hallucinations of persons and scenes—a kind of mirage. These are almost always constant for each patient. He had asked his biologic friends if it could be possible that an area of the brain like the hippocampal lobes which in the lower vertebrates through their acute sense of smell, performs some intellectual functions, could carry out at the earliest period of human life time primitive psychical functions and act as a store house of infantile memory. This hypothesis was based on the fact that each individual in his development from embryonic to adult life passed through successive stages analogous to those through which had passed the race. According to this idea memory pictures might be laid down in a very early period of life in the temporosphenoidal lobes and in a later period a more highly placed mechanism perhaps in the frontal areas might be put to the same purpose. These early memories would pass into subconsciousness and only be occasionally facilitated to consciousness and in the presence of gross irritation of this area. Such incoordinated resuscitations of memory pictures of a long past and forgotten time of life may account for the phenomenon of the "déja bu"—that odd sense of having lived through similar experiences which has come often to everyone, references to which are scattered throughout our literature and which to some are an intimation of an immortality in the past as well as in the future.

Dr. La Salle Archambault of Albany said that to the men who had devoted considerable time to the study of anatomy, Dr. Cushing's splendid communication was a source of comfort and gratification. It meant that some of the conclusions reached by the anatomist, which only too frequently were regarded as having a purely academic interest, had eventually been substantiated by critical neurosurgical observation and thereby acquired actual significance in the practical interpretation of important clinical problems.

Dr. Cushing's detection of quadrantal defects in the visual fields in cases of temporal lobe tumors was a reward for the anatomist and an inspiration to continue with renewed fervor the painstaking labor of laboratory research.

From his own studies of the intracerebral visual paths, Dr. Archambault was led to believe that the fibers of the geniculo-calcarine tract engaged in the ventral detour around the anterior portion of the temporal sphenoidal horn were mainly those fibers derived from the antero-inferior portion or segment of the geniculate body. Under these circumstances one expected an upper quadrantal defect to be especially characteristic of anterior temporal lobe tumors, whether this tumor was located near the superior or the inferior aspect of the temporal lobe. It seemed very evident from the charts and diagrams, that this was more frequently the case.

The speaker was glad that Dr. Cushing had questioned the propriety of designating the ventral detour by the term "Meyer's loop." While it was acknowledged that we were profoundly indebted to Dr. Adolf Meyer for his many valuable and illuminating contributions to the anatomy of the cerebral tracts and more particularly perhaps to the geniculo-calcarine tract, it was only fair to call attention to the fact that the geniculo-calcarine tract as such, including its ventral detour was originally described by early investigators, notably by Niessl, von Mayendorf and by Archambault. This criticism was not intended as a suggestion that the name of some other individual be substituted. It was preferable to abandon all such nondescriptive terminology and to call this loop the ventrosphenoidal loop.

Dr. Charles A. Elsberg of New York said that he had recently operated on a patient of Dr. Tilney's, who had signs referable to the left temporal lobe. In this patient there was evidence of a disturbance in the visual fields: while for form there was complete homonymous hemianopsia, he failed to recognize the movement of a finger or an object in the right lower quadrant of each visual field. The patient had a temporal lobe tumor.

The so-called "Meyer's loop" corresponds roughly to what Henschen called the inferior longitudinal fasciculus, which runs around the posterior and inferior horn of the lateral ventricle.

Unfortunately, it is not known what course the central fibers take. In several patients with temporal lobe tumors there have been large scotomas and more attention ought to be paid to enlargements of the blind spot. Special attention was recently called to this by Dr. de Schweinitz of Philadelphia.

Dr. William G. Spiller, of Philadelphia, said that Dr. Frazier and he had been considering the lesions of the pituitary body in regard to the visual fields, and he would be pleased if Dr. Cushing would emphasize the differences in the fields of vision of pituitary and temporal lobe lesions independent of other findings indicating the location of the lesion, as Dr. Cushing had stated the cutting of the visual fields might be the only localizing sign of tumor.

Dr. Cushing had said in the presentation of one of his cases that the preservation of the fixation point was a proof that the tumor could not be at the chiasm. Dr. Spiller asked for an explanation of this statement.

Visual hallucinations mentioned by Dr. Cushing had interested Dr. Spiller for a long time as a localizing sign of a lesion. Some years ago he diagnosed a tumor of one occipital lobe, partly from the visual hallucinations, and the tumor was not on the side on which it was supposed to be. He had doubted whether visual hallucinations from irritation of the visual paths were always in the blind fields.

Dr. Wells P. Eagleton, of Newark, said that early in his experience he had felt the need of further neurological and surgical knowledge and had gone to Dr. Cushing to obtain the proper technic. From him he had learned the importance of the perimetric examination in diagnosing tumors of the temporosphenoidal lobe. He stated that all the findings of tumor manifestations given in Dr. Cushing's paper were present without exception in all abscess cases. They were often overlooked because of the lack of a proper examination.

Dr. Adolf Meyer, of Baltimore, felt that it was a very interesting fact that we dealt with a condition evidently influenced greatly by the propinquity of the uncinate region, influence on which is known to produce more or less dreamy states, and it is known that any tendency to dreamy states is the most fertile opportunity for the formation of hallucinations. He believed that the more diffused irritation of the optic path is more likely to give constructive and pictorial hallucinations than something irritating more local.

Dr. Morton Prince, of Boston, said that he thought Dr. Kennedy had struck the right note. It was a question of interpretation. While it is true that hallucinations may be due to cerebral or cortical irritation it did not follow at all that the hallucination itself is correlated with any focal region of the brain. Dr. Kennedy had struck the right note when he said that it was as with dreams—that the irritation or stimulus, or whatever it may be, calls up previous memories, fixed memories of life, which functioning produce the hallucination. Dr. Prince said he put that remark in as a sort of caveat, which he would later explain in a paper which would be presented.

Dr. Harvey Cushing said that he was unconsciously led aside and evidently the Society had been led aside into the discussion of things which were of only secondary consideration.

The essential point was that in the geniculo-calcarine pathway (and that was what Dr. Meyer definitely called attention to) the fibers pursue a definite course throughout the pathway, and that course, curiously enough, is the same as the one pursued in the optic nerves and chiasm and tract. Hence, in spite of a relay the dorsal fibers remain dorsal, the ventral, ventral, all the way from retina to cortex.

In spite of the fact that there may be a bilateral auditory representation, it nevertheless seemed to Dr. Cushing very extraordinary that there should not be some disturbance of hearing, if the transverse temporal gyrus is as important a structure as is generally assumed. He pointed out in discussing these cases that even though the visual pathway bifurcates at the chiasm, nevertheless in the eye on the side of the lesion the defect in the fields may be considerably in advance of that in the other eye, and he saw no reason why it should not be expected to have some comparable auditory disturbance from a temporal lesion. If there is, it is less easy to determine. But such symptoms as one might detect on the part of the eighth pair appear to be related to the vestibular rather than to the auditory mechanism.

In the discussion of Dr. T. H. Weisenburg's paper, "Equilibration and the Vestibular Apparatus," Dr. Cushing spoke of the fact that these patients often showed certain vertigonous symptoms which suggested a cerebellar rather than a temporal localization.

Dr. Cushing said that he did not know that visual hallucinations were chiefly ascribed to the temporal lobe. It was not until he went over and tabulated the case histories very carefully, that he noticed their particularly common occurrence in temporal lesions.

In answer to Dr. Elsberg, he did not see what enlargement of the blind spot could have to do with the localization of temporal lobe lesions. He thought it was merely an evidence of general pressure, and consequently had no localizing value.

Dr. Spiller referred to the pituitary body. He did not believe there was any great difficulty, in the ordinary case, of distinguishing between the quadrantal defects produced by pressure against the chiasm and those due to temporal lesions, because the latter are usually accompanied with a high grade of choked disk, and in the former choked disk is excessively rare. He had only seen cases in a long service in which there was real difficulty in distinguishing them.

Another subject which had been touched upon concerned the macular bundle. Perhaps the subject should not have been mentioned and Dr. Cushing said that he did not feel justified in stating definitely that in lesions of the temporal lobe, affecting the visual pathway, the macula is more apt to be spared than in chiasmal lesions, but nevertheless he thought that it is generally the case.

Dr. Eagleton's reference to the field defects seen with an abscess in the temporal lobe was of course true. Dr. Cushing did not touch upon abscess nor upon traumatic lesions in his presentation, though his entire paper contained a few examples. He was surprised that the studies of the war material had not brought out this matter very definitely. He had a brief note in his paper regarding abscesses and traumatic lesions, but the paper presented before the American Neurological Association dealt entirely with tumor cases.

SUBACUTE EPIDEMIC ENCEPHALITIS. Dr. J. H. Globus and Dr. I. Strauss, New York.

The clinical history and anatomic findings of the case here reported demonstrate an important departure from the observations made in the acute form of epidemic encephalitis. It differs also in many respects from the chronic form, as described by Economo. Instead of the infiltrations, adventitial reactions noted in the acute form and the destructive features of the chronic type, we are able to demonstrate in our case a well defined tendency toward a reparative process.

The case might clinically be grouped with the mild protracted forms of lethargic encephalitis, and should be termed subacute epidemic encephalitis. Early in its course it tended toward recovery, then for a period the condition remained stationary, and finally developed an acute, virulent recrudescence, which terminated fatally.

CASE REPORT

History.—A man, 53 years of age was admitted to the neurologic service of the Mount Sinai Hospital complaining of double vision, weakness of the left upper and both lower extremities, headache and vertigo. His family and past history could be regarded as negative, with the exception of an attack of grip four years previously, when he suddenly developed retention of urine lasting thirty-six hours, from which he recovered.

His illness dated back about six months previous to admission, when he began to complain of occasional headache and vertigo. Ten days before admission to the hospital, he complained for the first time of double vision, and a week later, while his eyes were being examined, his knees suddenly gave way, and he would have fallen, but for support. The following day his left hand became weak; he was unable to hold light objects, and a day later this weakness became more pronounced, and he could not flex the middle finger of his left hand. The weakness of the lower extremities became progressively worse, and to such an extent that on the two days directly preceding his admission to the hospital, he became extremely unsteady and his gait was ataxic.

Physical Examination.—The patient was well developed, but confined to bed. There was paresis of the lower extremities, and he had difficulty in gaining and maintaining the sitting posture. Mentally, he appeared alert, showed no impairment of judgment or intelligence, and was normal in his reactions to his surroundings. There was no evidence pointing to a disturbance of the cardiovascular, respiratory, alimentary or genito-urinary system.

Neurologic examination revealed: The pupils were normal in outline and in reaction to light and accommodation. On the left side there was complete paralysis of the external and internal recti, and incomplete paralysis of the superior and inferior recti and superior oblique. On the right side there was incomplete paralysis of the internal rectus. The fundi were normal, and there was present weakness of the left orbicularis palpebrarum.

Motor power was markedly diminished in all extremities, but more on the left side. There was no atrophy or fibrillary twitchings; repeated movements of an extremity rapidly caused fatigue without direct recovery of strength on resting. Electrical tests did not give myasthenic reactions. All deep reflexes were equally increased, the abdominal being diminished, but equal. Ankle clonus was not present; a slight Babinski sign was produced on the right side. The coordination tests could not be carried out at this stage because of weakness of the extremities of the patient.

The cerebrospinal fluid was under increased pressure. There were no cells present, but tests showed a faint trace of globulin and albumin. The Wassermann test was negative as was also that of the blood. Blood pressure was: systolic, 120; diastolic, 75. Urinalysis showed no albumin or casts. The temperature was normal except during the terminal stage, when there was a slight rise to 100.2 F.

Course of Illness.—Soon after his admission to the hospital there was slight improvement in the condition of the patient. He said he was gaining strength in his extremities. Examination revealed increase in motor power, and increased range in the excursions of the left eye. Prognosis based on these findings and on the general cheerful attitude of the patient appeared promising.

At the end of five weeks a sudden decline in his condition was manifested by increased ptosis of the eyelids, futher limitation of the eye movements, diminution of muscle power and impairment of speech, the latter becoming nasal. There was also difficulty in swallowing, with a tendency to regurgitate fluids, and accumulation of mucus in the nose and throat, making respiration difficult. This apparently was the fatal turning point in the course of the disease, for during the next eight days the symptoms became rapidly and progressively alarming. Complete bilateral ptosis, complete bilateral external ophthalmoplegia, extreme paresis of all extremities and paresis of the muscles of mastication appeared. The facial expression became mask-like, and there was almost complete dysarthria, denoting a rapidly advancing bulbar paralysis. which culminated in death.

Necropsy Examination.—The gross anatomy revealed extreme congestion of the leptomeninges, most pronounced at the ventral surface of the medulla and pons, the latter acquiring a dark purple hue.

Microscopic anatomy showed: (1) Lesions characteristic of the acute form of epidemic encephalitis, such as small round cell, adventitial infiltration, found only on close scrutiny in the region of the aqueduct of Sylvius and the inferior olive.

(2) Adventitial thickening, through proliferation of adventitial elements, and metamorphosis of the lymphocytes and polyblasts, leading to marked fibrosis of the outer wall of blood vessels.

(3) Intimal thickening through swelling and reduplication of the endothelial lining of the smaller vessels.

(4) Formation of small capillaries.

(5) Accumulation of rounded up, large glia cells about smaller vessels; similar focal aggregation of glial cells, marking recently completed processes of neuronophagia.

(6) Accumulation of lipoid substance in adventitia of large blood vessels.

(7) Extravascular hemorrhages, indicating the terminal and destructive action of the virus on vessel-walls.

(8) Absence of atherosclerotic changes.

SIGNIFICANCE OF THE HISTOLOGIC CHANGES OBSERVED

It is evident that the modification of the structure of the small and medium-sized vessels forms the most prominent feature in this case. These findings, together with the observations made as a result of examining anatomically a series of six cases of the acute form of lethargic encephalitis, lead us to the belief that the primary attack of the virus is on the wall of the small and medium-sized vessels, and that the vessel wall is affected by the virus in a manner proportionate to its virulence.

It appears that production of elements of infiltration, destined perhaps to repair damage occurring in the immediate vicinity of the vessel, is an important function of the adventitia. Thus, when the virus or even a mineral poison reaches the adventitia, it reacts by formation of adventitial elements, provided that vessel wall is not damaged to the extent of losing its potency for adventitial proliferation. Should the virus or toxin, however, be so destructive to the vessel wall as to incapacitate it for cell proliferation and weaken it so it cannot withstand the pressure of vascular engorgement, perivascular hemorrhages will occur in large numbers, a feature characteristic of the acute, virulent type of the disease.

The reverse is also true, for when the virus reaches the vessel in a small amount or in attenuated form, changes pointing to subacute lesions follow, as was shown in our case. Such interpretation of the histologic changes in the brain lead us to suggest the grouping of epidemic encephalitis into: (1) an acute infiltrative form, with dominant feature of perivascular infiltration, (2) an acute hemorrhagic form, in which the virulence of the disease is expressed in numerous extensive hemorrhages, and (3) the subacute productive form, as described in this paper.

The acute infiltrative form is the early stage of any acute form of acute epidemic encephalitis, which may resolve itself rapidly into the fatal hemorrhagic type or the protracted, mild productive form. The anatomic changes in this case, we believe, afford sufficient basis for the hypothesis that the sequelae which frequently follow an attack of acute epidemic encephalitis are due mainly to vascular changes in the parenchyma. Thus, it is not at all improbable that in the various postencephalitic conditions of a progressive character, as for instance in the parkinsonian type, we are dealing with a more or less localized lesion, characterized by progressive adventitial and intima changes in the cerebral vessels which are accompanied by gliosis and secondary parenchymal degeneration, and which are directly responsible for the clinical manifestations.

DISCUSSION

Dr. Walter F. Schaller of San Francisco said that recently in the Stanford Clinic a somewhat similar case had been studied. Fourteen months before coming under observation the patient passed through an illness diagnosed as epidemic encephalitis of the bulbar type with characteristic symptoms of lethargy, double vision and nystagmus. He apparently recovered from the acute infection but never entirely regained his strength or vigor.

He entered the medical service with abdominal complaints of pain, spasm and gastric distress, which led to the suspicion of a local abdominal lesion. Medical treatment was unsuccessful, and the patient was finally referred to the surgical clinic for an exploratory laparotomy. No gross lesions were found but an atrophic appendix was removed. This showed later on histologic examination a mild chronic appendicitis, but did not satisfactorily explain the clinical picture. After the operation the patient developed a progressive bulbar paralysis, which four days later caused his death.

A complete necropsy was performed by Dr. Jean Oliver of the pathologic department. The brain showed the characteristic lesions of epidemic encephalitis, most marked in the central ganglions and the brain stem. In addition to the lesions described in the case of Drs. Strauss and Globus, namely, perivascular cell infiltrations, hemorrhages, satellitosis and scavenger-cell formation about the vessels, there occurred in Dr. Schaller's case a deposit of amylaceous bodies and a patchy gliosis of mild degree resembling somewhat the plaques of disseminated sclerosis.

Dr. Peter Bassoe, Chicago, said that the case of Drs. Strauss and Globus was interesting because it tended to show that there was a bridging over between the purely infiltrative encephalitis as exemplified by lethargic encephalitis and the productive type best exemplified by lead encephalitis.

Dr. Bassoe said that those who attended the Research Meeting in Nw York might remember Dr. Hassin's demonsration of the lesions of lead encephalitis, showing great proliferation of the intima of the vessels and new formation of capillaries. The case reported by Drs. Strauss and Globus showed that the productive type of inflammation might also be present in epidemic encephalitis of long standing.

CHICAGO NEUROLOGICAL SOCIETY

Regular Meeting, Oct. 20, 1921

C. F. Read, M.D., *President, in the Chair*

SPASTIC PARAPLEGIA DUE TO INFECTIOUS GRANULOMA ON THE DURA; OPERATION, RECOVERY. Dr. Edwin W. Ryerson (by invitation).

A young woman, aged 20, was well in the summer and fall of 1919. In December of that year she fell from a small step-ladder and hurt her left shoulder. The injury was not severe, but she complained for two months, of numbness and occasional pain in the arm and shoulder, and in February of 1920 she went to the Presbyterian Hospital on account of slight loss of weight and loss of appetite. The stomach contents showed moderate hyperacidity, and a tentative diagnosis of gastric ulcer was made. Under treatment, her general condition improved, but there was occasional complaint of pain in the shoulder.

Present Illness.—On May 30, 1920, she had a sudden attack of fever and chills. Her throat was not sore, and the chills lasted only two days. She was obliged to go to bed and for two weeks the temperature ranged from 100 to 103 F. The left shoulder became more painful than previously.

On June 9 she suddenly became completely paralyzed from the waist down. This paralysis was flaccid in character, and was considered possibly an anterior poliomyelitis by a neurologic consultant. A week later the paralysis became spastic, and so remained. In two weeks from the onset she became able to control the bladder, and normal bowel function returned in about two months. The paralysis of the legs gradually improved, and in October the patient was able to walk about a little with crutches, but no further improvement was noted after November, 1920.

She was seen at various times by several consultants, and a Taylor spinal brace was fitted, presumably under the impression that a lesion of the vertebrae, tuberculous or otherwise, existed. Several roentgen-ray plates were made, and a small, punched-out area was indistinctly seen at the lower border of the fourth dorsal vertebra.

I examined the patient in the fall of 1920. She then showed a typical spastic paraplegia of moderate degree. She was able to walk with great difficulty, wearing the Taylor brace. There was no pathologic kyphosis and no muscle spasm.

The history of the onset and subsequent course of the trouble did not suggest tuberculous spondylitis. While sudden paraplegia is sometimes the first definitely noted symptom in adult cases of Pott's disease, such paraplegias are not ordinarily ushered in by chills, fever and pain, such as occurred in this case. The roentgen-ray findings at the time of this examination were not characteristic of spinal tuberculosis.

It was considered probable, therefore, that there had been a hematogenous infection in the immediate neighborhood of the spinal cord which had produced a pressure paraplegia. Acute osteomyelitis of a vertebra would explain the symptoms, and the appearance of the fourth dorsal vertebra on the roentgen-ray plate could be interpreted to support this view. No definite improvement had been noticed for some months, but neither had the patient become worse. Laminectomy and exposure of the cord is attended by little danger, when properly performed, and I considered it justifiable in this case. The patient entered the Presbyterian Hospital on Jan. 25, 1921, and was examined again by Dr. Bevan, who did not advise operation. Dr. Peter Bassoe then saw her and concluded that a laminectomy was desirable.

Dr. Bassoe's Report.—The main findings on neurologic examination were: Motion: The patient could lift either leg from the bed. Flexion and extension at the ankles was good. Eversion of the right foot was weaker than that of the left. Plantar flexion of the small toes and of the left large toe was quite strong; of the right large toe weak. Flexion and extension at the knees and all hip movements were fairly strong. With the hands folded on the chest the patient was not able to raise herself to a sitting position, but there was distinct contraction of the rectus abdominis and of the erector spinae. Beevor's sign was not present. Apparently there was some weakness of the lower intercostal and abdominal muscles, and the chest expansion was not good. The strength in the arms was normal. Reflexes: The bilateral Babinski sign and knee and ankle clonus were present. The abdominal reflexes were present, the upper stronger than the lower. The arm reflexes were present but rather weak. Sensation: Touch, pain and temperature sensation were normal. Sense of passive movement was distinctly impaired in the toes, at the ankles, knees, and left hip; it was normal at the right hip. Vibration sense was much impaired on the bony points of the right lower extremity, slight on those of the left and moderately impaired on the iliac crests and on the lumbar spines; it was slightly impaired on the lower ribs. Ataxia of the legs and arms was present.

Lumbar puncture on January 27 yielded a clear fluid under low pressure. The Wassermann reaction was negative; the Ross-Jones globulin test was positive; the result of the Lange colloidal gold test was 0112221000. There was not sufficient fluid for a cell count. The leukocyte count in the blood was 7,750, hemoglobin 90 per cent.; the blood pressure was: systolic 120, diastolic 68. The urine was acid and cloudy, with an increase in leukocytes and epithelial cells; otherwise it was normal.

The temperature on admittance was 99.2 F. and did not rise above 99 F. prior to the operation.

Treatment and Course.—On January 29, therefore, the arches of the second, third and fourth dorsal vertebrae were removed. At the level of the fourth, the upper end of a bluish mass was seen on the cord, and the arches of the fifth and sixth were accordingly removed. This exposed completely a mass about 1 inch (2.54 cm.) in length by ⅜ inch (9.51 mm.) in width, and ¼ inch (6.35 mm.) thick, lying on the dura. It was bluish-purple, and apparently composed of granulation tissue. It had no connection on any side with the vertebrae, nor was there any sign of infection or osteomyelitis of the laminae or articular facets or spinous processes of the vertebrae. As we looked at the mass of tissue, a small drop of pus was seen slowly exuding from the upper-most surface. With a sharp knife the entire mass was carefully sliced off from the dura. There was no evident perforation of the dura, and it did not seem to be thickened or involved in any marked inflammatory reaction, although it was slightly darkened in color.

No other pathologic condition being apparent, the wound was closed in layers, two small drains being inserted at the middle of the incision. The patient suffered considerable pain for several days after the operation, and there was free drainage for about three weeks, after which the wound closed completely.

Cultures and smears from the granuloma showed staphylococcus.

The progress of the case has been most satisfactory. The girl is able to walk about the room without a cane, but when outdoors prefers to use one. There has been no development of kyphosis, and the back feels perfectly strong. The improvement in walking has been continuous, and the knee reflexes are much less active, although they are still somewhat exaggerated.

To form a definite conclusion as to the etiology of this infectious granuloma is difficult. It may have been due to osteomyelitis of a vertebra, but this could not be demonstrated at operation. Possibly the communicating tract had become so well obliterated that it was macroscopically invisible. It is barely possible that a local hematogenous infection occurred primarily on the posterior surface of the dura. I do not know.

The patient is presented as an example of the difficulties sometimes encountered in the diagnosis and treatment of lesions of the spine and spinal cord.

DISCUSSION

Dr. Peter Bassoe: There was no way of telling the exact level of the lesion except from the history of the case at the time of the acute attack and the roentgen-ray appearance. There had been nine days of fever and pain prior to the paralysis, with a temperature of from 101 to 103 F. Spinal puncture at that time revealed a fluid wih 12 cells per cubic millimeter and a negative globulin reaction. There was paresthesia from the costal margin down and anesthesia from the pelvis down.

Considering everything, it seemed to me reasonable to suspect pressure on the cord. The roentgen-ray appearance was different from anything I had ever seen, and I thought it indicated the level of the lesion. Whatever it was due to, the peculiar appearance in the roentgen-ray plate was at exactly the point of the tumor-like growth.

The histologic specimen showed the structure of a granuloma, with large cells lying in a loose reticulum, and many polymorphonuclear cells. I think the growth was of inflammatory origin at the level of a bony defect, and that there must have been an osteomyelitic process either in the body or arch through which the infection had extended and produced the inflammatory nodule.

Dr. Hugh T. Patrick: I presume I am the neurologic consultant mentioned by Dr. Ryerson, and I regret that my notes are not more complete. However, I have an account of the onset which probably is more exact than that obtained by Dr. Ryerson, as mine was received only a few days after the onset.

The early symptoms were exactly as Dr. Ryerson has stated. In May the patient had a severe headache, with fever; she was purged and in a few days was all right. Evidently she had some acute infection. I saw her on June 13. On June 7 she began to have pain in the back, between the scapulae, and the attending physician found some fever. The fever continued, and two days after the beginning of the pain it was noticed that the legs were weak, especially the right, but she could still walk. The next day she could not walk; that is, the paraplegia came on rapidly but not suddenly: certainly not with sufficient suddenness to indicate a vascular origin. Dr. Volini, with whom I saw the patient, had first seen her only two days previously (June 11) and the day before that she had had tingling in the legs so intense and disagreeable that she was given a hypodermic of codein. Two days before I saw her the temperature was 101.2 F., later 101.6 F., and for two days it had ranged from normal to 100.8 F. Off and on, but not very severely, the pain between the shoulders had continued. There was still slight paresthesia of the legs, not so high as the pelvis. She had had retention and had been catheterized. Lying in bed she could move the left leg but could not move the right one.

The symptoms were conflicting. There was slight sensory impairment. The paraplegia was essentially flaccid, but she had a double Babinski sign. The case looked like an acute transverse myelitis, but I do not believe much in transverse myelitis; at least I believe it to be a great rarity, about the last thing in a transverse cord lesion that one is justified in assuming. Sometimes a spinal caries announces itself by a rapidly appearing paraplegia. I have seen one such case in which the patient's first symptom was falling down on the street from weakness of the legs. Poliomyelitis was suggested, but the double Babinski sign was evidence against it, even though this sign has been observed in poliomyelitis. The sensory disturbance also was evidence against poliomyelitis, although such slight sensory symptoms have been seen in this disease. I did not think of osteomyelitis at all, but should have done so in the presence of an acute infection; but I have never seen osteomyelitis with so little systemic disturbance. Therein lies one of the instructive features of the case: after a trifling systemic infection with only a few symptoms there occurred a focus which certainly compressed the spinal cord. Whether it did more than this we do not know, but it must have been of exceedingly rapid development. The fever and mode of onset excluded a vascular lesion. There was no reason to suspect a syphilitic lesion and the Wassermann reaction was negative. The diagnosis may have been easier afterward, when she developed further symptoms of a different type. In any event, I entirely failed to make the diagnosis.

Dr. George W. Hall: A child of about 2 years of age, when admitted to St. Luke's Hospital, presented the clinical aspects of chloroma. The case had been diagnosed as one of acute anterior poliomyelitis a few weeks prior to that time. The early symptoms were acute onset with pain in the lower dorsal region, followed in a day or two by paralysis of both lower extremities and diminished knee reflexes. Within a short time a tumor involving the skull over the right frontal region with rapidly increasing unilateral exophthalmos, developed. The child was taken home after one week in the hospital so the case was not followed to necropsy.

Dr. Ralph C. Hamill: The combination of flaccid paralysis with extreme involvement of the sense of passive movement, without much interference with superficial sensation, is something that must occur quite frequently in extradural growths, especially on the back of the cord. I have just seen a man who had had severe pain in the lumbosacral region, and pain in one leg. He went to an osteopath, who dug and pulled at his back and immediately the patient had pain in the other leg. After the second osteopathic treatment he developed flaccid paraplegia. When first seen he had marked loss of sensation in the distribution of the anterior crural nerves; flaccid paralysis was present in both legs, and there was marked loss of the sense of passive movement, especially in the right foot. At operation there was found to be a sarcoma in the muscles outside the spine and apparently protruding in between the laminae, causing pressure in the neighborhood of the first lumbar segment.

Dr. Patrick: I did not mean that caries and anterior poliomyelitis were the only things considered. There was a question whether it might be a multiple neuritis and also an acute multiple sclerosis, which sometimes comes on very rapidly, but there was too much pain. The symptoms did not fit in with either of these conditions.

Dr. Edwin W. Ryerson (closing): There were no atrophies at all. All the muscles functioned with as normal an amount of power as one would expect in a person who had been so long paralyzed.

A CASE OF ADIPOSIS DOLOROSA. Drs. H. I. Davis and Seymour J. Cohen.

The patient was a pedler, aged 49 years, whose family and personal histories were negative. Eight years ago a small painless tumor appeared on the left forearm, since which time numerous others had appeared, all gradually growing until he had dozens of them varying in diameter from 0.5 cm. to large confluent masses 21 by about 17 cm. When they reached a diameter of about 2.5 cm. they became tender and painful. They were most numerous and largest on the front of the thighs, plentiful on the arms, forearms and abdomen and were freely movable. There were none on the face, neck, chest, back, legs, hands or feet and there was no general adiposity.

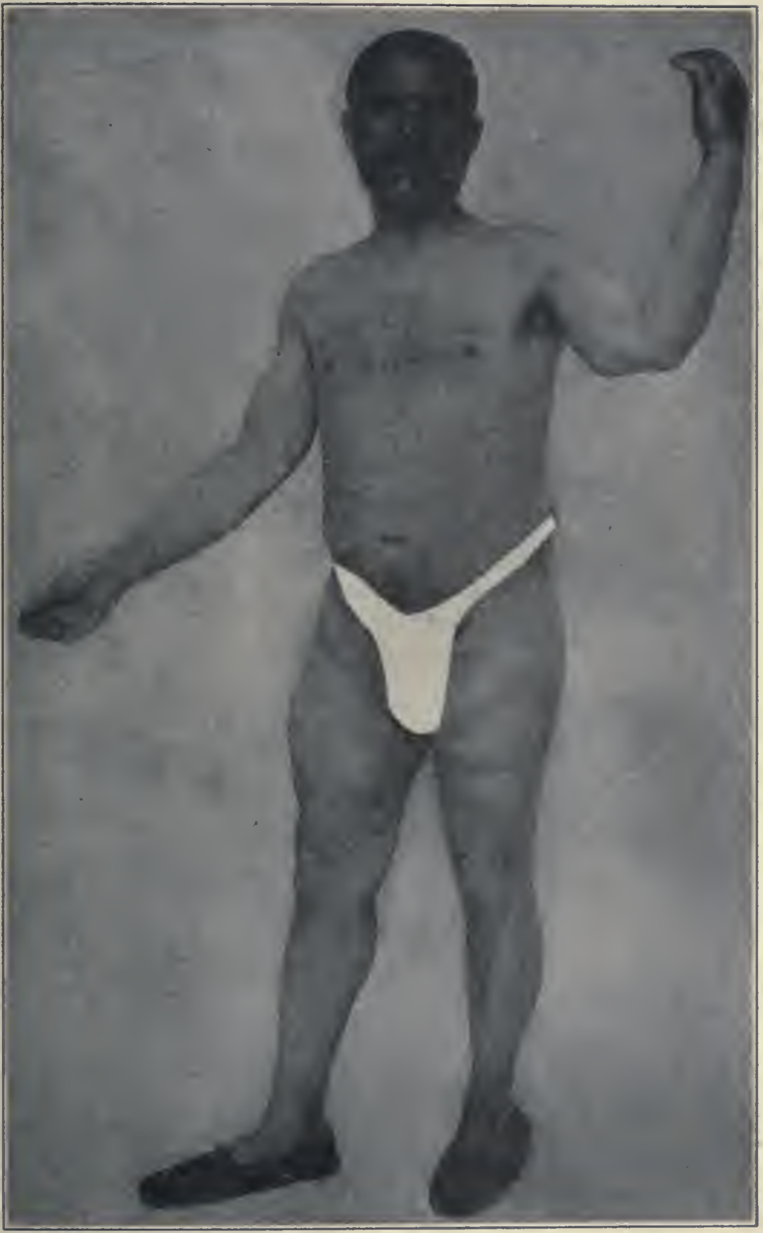
The patient's general condition was not good. Apparently he was worn out by pain and loss of sleep. He felt weak and walking upstairs caused dyspnea. But the heart, lungs and urine were normal, and he was not very anemic. Blood examination revealed: hemoglobin 85 per cent., red blood cells 4,600,000, white blood cells 11,400; blood pressure: systolic 145. The blood Wassermann reaction was negative and signs of syphilis were absent. The tonsils were large, ragged and hyperemic; there was no thyroid enlargement; the abdominal organs were normal, and the roentgenogram of the skull showed a normal sella. The basal metabolism was 3.8 per cent. above normal.

The results of the neurologic examination were negative. On July 5, 1921, four of the tumors were removed. They were composed of fat and connective tissue and each one was covered with a thin fibrous capsule. No nerve fibers were seen, but special staining methods were not used.

The blood chemistry was practically normal except that the percentage of blood sugar was high, 0.126 per cent. The results of the sugar tolerance test are given in the table.

Results of Test of Sugar Tolerance

	Blood Sugar, Percentage	Urine Sugar, Percentage	Total Sugar, Mg.
9:25	0.116	0.068	17.7
9:30 ingested 70 gm. of glucose (1 gm. per kg. body weight)			
10:00	.....	0.090	27.0
10:30	0.224	0.217	33.5
11:00	.....	0.748	82.4
11:30	0.204	0.585	76.2
12:30	.....	0.182	22.8



Adiposis dolorosa.

This shows diminution of sugar tolerance.

Previous investigators differ in opinion as to the etiology of the disease, but most of them incriminate glands of internal secretion; thyroid, hypophysial or glands of reproduction. If our case shows anything in this respect, it rather indicates disorder of the pituitary function.

DISCUSSION

Dr. Hugh T. Patrick: How does Dr. Davis account for the position assumed by the patient; why does he walk bent over? Also, how many of the cases reported showed simply multiple lipomas without any adiposis? This man has multiple painful lipomas but is not fat.

Dr. H. I. Davis: I think the man's posture is due to pain under his knees when attempting to straighten. Up to 1910 there were about 200 cases of Dercum's disease reported. None of the patients described by Dercum was extremely fat, but a good many were fat. The cardinal symptoms were pain and fatty tumors.

Regular Meeting, Nov. 17, 1921

C. B. Read, M.D., *President, in the Chair*

A CASE OF POLIOMYELITIS WITH SYMPTOMS OF LETHARGIC ENCEPHALITIS. Dr. Harold N. Moyer.

It is a question whether this case should be reported as one of lethargic encephalitis of a poliomyelitic type or whether it should be called poliomyelitis with lethargic symptoms. Additional interest is lent to the case because of a traumatism closely associated with the onset of these symptoms.

The accident occurred on July 15, 1918, about 8 o'clock in the morning. In loading baskets onto a truck, the patient's leg went down between the truck and platform in such a way that he fell backward, striking his back and the back of his head. He immediately got up, thinking nothing of the trifling fall. A few minutes later a fellow worker called his attention to a drop of blood on his head. The wound required no suturing, and in a day or two was healed and he had no local disturbance.

The next day he went to work as usual but as the morning advanced he gradually became tired, drowsy and indifferent and at noon he went home. He moped about the house for the remainder of the day and there was no significant alteration of his condition until two days later. While seated at the supper table his legs, which had felt tired and weary, suddenly lost all power. He supported himself by his elbows on the table. With assistance he undressed and went to bed, and in a short time lost the power of raising his head or moving his legs, though he says he always retained the ability to move his toes and fingers to a slight extent. Catheterization was necessary on three occasions. For the following five days he was somnolent with some dimming of consciousness, but at no time were his mental faculties impaired so that he could not answer questions. During this period he suffered a good deal of pain and had a temperature of 101.5 F. In this first week he had double vision which lasted for about one week and then gradually disappeared. The pains which were severe and not localized gradually passed away and at the end of six weeks he had no pain and has had none since. There was a slight steady improvement in the paralytic symptoms, which at the end of six months had so far abated that he was able to stand with help. By the end of 1919, that is, fully eighteen months after the onset of the trouble, he was able to walk alone, but he had to use his hands to raise himself to a standing position. During 1920, he was able to go out on the sidewalk and during the following winter he was able to walk six or eight blocks. In the spring of 1920 he was able to go up and down stairs when he had something to hold onto. At present he is able to stand and walk. He is not able to rise from a low seat without assisting himself by his arms. From a comparatively high chair he can bend his body forward and gradually get into an upright position without the assistance of his hands. Once on his feet he walks with comparative ease on a level surface.

The muscles of the body are all more or less wasted. All show some diminution in size, but no single muscle is completely atrophied and out of use. The muscular weakness is his only disability. His general health is not impaired; sensation is not altered, and his mind is clear.

The electrical examination was imperfect and not very satisfactory as it was confined to the investigation of the reactions with the faradic current, so that partial reactions of degeneration could not be determined. None of the muscles seemed to be completely out of use.

DISCUSSION

Dr. Julius Grinker: This is undoubtedly a case of poliomyelitis. We are dealing here with an unusual type of poliomyelitis only as far as the onset is concerned.

Dr. Sigmund Krumholz: It is unfortunate that the spinal fluid could not be examined. In poliomyelitis the cell count is much higher than in lethargic encephalitis. The diagnosis of lethargic encephalitis is favored in this case by the extensive involvement and by the progressive improvement. In the Heine-Medin disease, after the improvement following the early stage, the paralysis usually remains stationary. Again, lethargy is unusual in infantile spinal paralysis, therefore the somnolence, which, I understand, this patient presented, would favor the diagnosis of epidemic encephalitis. The lethargy in the latter disease is probably caused by an edema in the region of the aqueduct of Sylvius.

Dr. Moyer: If this case is regarded as poliomyelitis in contradistinction to encephalitis, it is a rather striking example of the former disease. As a rule the disease is not as symmetrical and not as general as in this case. The onset corresponded closely to that of an ordinary case of encephalitis. There was early diplopia with somnolence and lethargy associated with fever.

DEMONSTRATION OF A SPECIMEN OF CEREBRAL TUMOR SIMULATING HYDROCEPHALUS. Dr. Lewis J. Pollock.

The brain which I am presenting was removed from the skull of an infant a little less than 4 months old. In it there is a fibroma of the right occipital lobe which apparently originated in the dura mater and which has undergone sarcomatous change. I am presenting this specimen to illustrate an error in diagnosis. This error occurred because of the interpretation of conditions ordinarily present in obstructive hydrocephalus. This child was born normally at full term, had no difficulty in respiration, was breast fed and showed no abnormality until it was about 3 months old, when it was observed that it did not take as much interest in its surroundings and that the head began to increase in size. This increase in size was rapid and extreme. When, at the age of 3 months and three weeks, it was examined by me, no paralysis or paresis was observed, there was a marked increase in the size of the head, the eyeballs rolled downward and were immobile. No abnormal reflexes were found and no rigidity was present. There was bilateral optic neuritis with secondary optic atrophy. A clinical diagnosis of hydrocephalus was made and for the purpose of localization and etiologic diagnosis the following procedures were carried out: A lumbar puncture was performed and clear fluid obtained which contained a trace of globulin. A puncture was made at the lowest angle of the posterior fontanel on the right side, into what was thought to be the lateral ventricle. This puncture brought a chrome colored, slightly bloody, fluid. Into what was considered to be the lateral ventricle were injected 5 c.c. of indigocarmin solution. We were unable to recover any of the stain through the needle inserted into the lumbar subarachnoid space, and were likewise unable to recover any by means of a cisterna magna puncture. From this we deduced that we were dealing with an obstructive hydrocephalus from obstruction in the acqueduct of Sylvius. It was considered that a tumor was the most probable pathologic condition producing the obstruction. The child was operated on by Dr. Allen B. Kanavel to determine whether an artificial aqueduct could be constructed. After the cerebellum was lifted upward, in the upper angle of the fourth ventricle was observed a bluish, pea-like protuberance, which was punctured and yielded the same fluid as was obtained from what we considered to be the lateral ventricle. A ventricular puncture on the left side yielded a clear fluid. Nothing more was done at operation and the child died two days later. At necropsy it was seen that what was considered to be the right lateral ventricle was a cyst which was not connected with the lateral ventricle. The lateral ventricle itself was divided into four compartments by thin septums.

Although it is true that an obstructive hydrocephalus was present, the actual clinical diagnosis as related to the anatomic findings was incorrect in that the existence of a cyst was not considered. It appears to me that this is an important case, demonstrating the possibility of error even when objective facts dealing with the mechanics of the cerebrospinal fluid and ventricles seem to point positively to the existence of a simple obstructive hydrocephalus.

PRESENTATION OF A SPECIMEN OF GLIOMA OF THE LEFT FRONTAL LOBE FROM A PATIENT WITH A CHEMICAL PICTURE OF GENERAL PARESIS. Dr. G. B. Hassin.

This brain comes from a patient who entered Cook County Hospital with symptoms that much resembled those of general paresis. He was markedly demented, showed pupillary changes, aphasic disturbances and gave a definite history of syphilis. His Wassermann reaction was negative (the patient received regular antisyphilitic treatments).

The diagnosis rested between lethargic encephalitis and general paresis.

The postmortem examination revealed a glioma of the left frontal lobe and a large hemorrhagic cyst. This occupied the greater portion of the left lateral ventricle which appeared enormously distended. Its walls were covered by a thickened capsule which, in some places, was adherent to the ependymal wall of the ventricle.

The interest of this case is, pathologically, the extent of the hemorrhages with subsequent cyst formation that may be caused by a glioma and, clinically, that frontal lobe tumors may cause symptoms of general paresis.

DISCUSSION

Dr. Julius Grinker: The specimen reminds us that gliomas may become multiple without symptoms until a portion of the brain not silent is affected. Some years ago I saw a patient who had received a head trauma and was thought to have suffered from a hemorrhage resulting in hemiplegia. It was a question of diagnosis between abscess and hemorrhage, because trauma had preceded the development of the hemiplegia. The patient died following operation. Necropsy revealed three gliomas. Two small tumors were found in the frontal lobe and another had extended into the internal capsule. The latter tumor had been accompanied by a large hemorrhage which produced the hemiplegia; there were no symptoms up to that time.

SAN FRANCISCO NEUROLOGICAL SOCIETY

Eleventh Regular Meeting, Nov. 4, 1921

Henry G. Mehrtens, M.D., *Secretary, in the Chair*

RESULTS OF REEDUCATION IN A CASE OF BIRTH PALSY. Dr. Henry G. Mehrtens.

A young woman had a birth palsy involving the right extremities, particularly the right hand, so that when first observed she could do no more than move her fingers in hinge fashion. By the aid of reeducational exercises she has improved so that she can clench her fist with a dynamometer strength of 7.5 kg., and write with the affected hand. The improvement in the appearance of the hand has been remarkable. The hand was clammy, cold and white; now it has become warm and moist. But more remarkable has been the general improvement. The exercises have stimulated the whole organism so that the general appearance of the patient has changed for the better. In these cases of birth paralysis the defects are more than local.

A PATIENT SHOWING SIGNS OF CONUS LESION WITH NO PATHOLOGIC CONDITION ON OPERATION. Dr. Henry G. Mehrtens.

This case is a commentary on our clinic system. The patient had a possibly syphilitic infection in 1915. After a positive Wassermann reaction the test was repeated and found negative. A slight rash was treated by calamine lotion. In 1916 the nose and throat clinic ordered the performance of another Wassermann test, which was negative. She was referred to the orthopedic clinic for the pain in her back, where scoliosis of the lumbar spine was diagnosed and antisyphilitic treatment was given. The Wassermann reactions from time to time remained negative. In 1920, she developed pain in the left thigh with numbness of the leg. She was referred to the neurologic clinic where a lumbar puncture was performed and a physical examination was made, with negative findings. The gynecologic clinic diagnosed a lacerated cervix and rectocele. The cervix was cauterized. A dentist removed all her crowns and bridges, suspecting focal infection. In 1921, several roentgenograms were taken of the spine, and she was measured for a belt in the orthopedic clinic. She was then referred to the physiotherapy department for baking and massage. Again she was referred to the neurologic clinic, complaining of pain in the left hip. Worries and dreams about a wayward daughter suggested psychanalysis, and the analysis was made. A roentgenogram of the nasal sinuses showed slight clouding of the membranes of the antrum, and this condition was treated in the nose and throat clinic. Finally, sacral pain radiating down the back part of both lower extremities and incontinence of both rectal and vesical sphincters presented something definite. A riding-breeches anesthesia for all kinds of superficial sensation was then found and also absence of the Achilles reflexes. Further roentgenograms of the sacrum and pelvis were negative.

Diverging opinions were expressed as to the probability of a cord tumor and of syphilis. On the basis of her former history she was given mercury and arsphenamin. No benefit following this treatment, a laminectomy was performed and the conus exposed. It appeared rather small, but showed no evident pathologic condition; neither were the caudal nerve strands altered in appearance. A probe passed up and down the spinal canal encountered no obstruction.

DISCUSSION

Dr. Howard C. Naffziger: How was a sacral lesion within the canal involving the lower sacral roots excluded?

Dr. Walter F. Schaller: Dr. Mehrtens and I had not seriously considered this possibility for several reasons: first, on account of the symmetry of the sensory involvement suggesting cord rather than root lesions; second, because of the absence of the intense pain and suffering so characteristic of lesions due to root involvement or pressure; third, because of the absence of any radiographic or local evidence of sacral disease.

A CASE OF SOMNOLENCE AND OBESITY FOLLOWING ACUTE EPIDEMIC ENCEPHALITIS. Dr. Henry G. Mehrtens.

The patient, a middle-aged stevedore, two years ago had a severe attack of influenza followed by diplopia and dull pain in his legs. The diplopia persisted for a few weeks and has not reappeared. After recovering from influenza he entered a hospital because of weakness and sleepiness. A Wassermann test was found positive, and arsphenamin was administered. His sleepiness, however, increased. He gained rapidly in weight, his weight increasing from 215 to 265 pounds. Since that time his sleepiness has persisted, and he cannot retain employment because he cannot remain awake long enough to do his work. He falls asleep whether sitting or standing.

There was a rather striking history of family obesity.

The examination recently made revealed no evidence of syphilis or other organic disease. The cerebrospinal fluid was negative. He was especially examined for evidence of pituitary disease. No evidence of this was found either in the pharmacologic or metabolic tests. Pituitary feeding has been without benefit. A limited diet, to which he would not adhere, was the only means of rendering him less somnolent.

The case resembles those of pituitary tumor and other tumors pressing on the floor of the third ventricle. It is probable that encephalitic changes involving this locality were the cause of the condition.

A CASE OF POSTENCEPHALITIC MOTOR DISORDER CHARACTERIZED BY SPEECH INHIBITION AND BY DYSSYNERGIA. DR. WALTER F. SCHALLER.

Following an acute attack of epidemic encephalitis in 1919 of the lethargic type, a male adult, aged 22, presented a number of unusual motor symptoms. He was unable to articulate until a prolonged latent interval had elapsed due to involuntary inhibition which was especially increased by emotion and which occasionally entirely prevented speech. Before speech was established, the mouth opened widely and saliva was frequently swallowed. Words and sentences were spoken in a slow scanning manner with only a slight dysarthria at times affecting the linguals.

The gait was stiff and jerky. The forearms were slightly flexed on the arms. While walking, the normally present associated movements in the upper extremities were absent. Adiadokokinesis was present in the right upper extremity and to a lesser degree in the left. Both upper and lower right extremities presented dysmetria. Muscular tonus was not increased in any muscle or muscle groups. Neither slow nor abrupt passive motion caused rigidity. The normal rebound reflex was present in the forearms. Involuntary movements were infrequent. The eyelids closed suddenly and could not be opened until the patient raised his upper lids with the fingers. Whereas there was habitually little play of facial expression, the patient had himself noticed a tendency to forced laughing. Several times a day, and especially when under emotional stress, the right hand and forearm underwent a rhythmical rotary movement. The patient could write quite legibly notwithstanding these abnormal motor phenomena. His mentality had not suffered.

The inferior tendon reflexes were exaggerated, and the Babinski sign was bilaterally present. Somatic sensation was unaffected and muscular force was not diminished. The clinical picture had remained the same for the past year. A prolonged course of speech reeducation had proved unavailing. It was evident that permanent and extensive lesions were present in the central nervous system. These appeared to have occurred especially in the corpus striatum and the cerebellorubrospinal system.

A CASE OF UNILATERAL ASCENDING PARALYSIS. DR. WALTER F. SCHALLER.

The patient, an American railway engineer, aged 58, had for eleven years noticed a gradually increasing stiffness, weakness and awkwardness of his left lower extremity. For the last two years his left upper extremity had become similarly affected, and latterly he could use it only with difficulty. Although the affected extremities felt colder than those of the opposite side there was no loss of sensation and no pain. There were no cranial nerve symptoms.

In 1890, the patient suffered a moderately severe injury to the back of his head by falling from his locomotive cab. Two months before the symptoms referable to his arm began he was thrown to the ground when cranking his automobile in gear. He struck his hip on a hard surface and attributed his later symptoms to that accident.

The physical examination and biologic tests in October, 1920, showed no evidence of syphilitic infection. The gait was markedly spastic on the left. The whole left lower extremity was held straight and walking was typically cyclic. The spasticity of the extensors in this extremity was remarkable, and it took great strength, time and patience passively to flex the leg on the thigh.

as, for example, when the patient knelt on a chair for the elicitation of the Achilles reflex. The foot inclined to the equinus position when the patient lay in bed. Evidently this was due to the spasticity of the calf muscles. Flexion of the thigh on the trunk was limited partly, at least due to spasticity of the hamstrings. These tendons were felt as tense cords when this motion was attempted. Abduction was limited. Spasticity in the left upper extremity was evident but did not show the flexor and extensor differences as in the lower extremity. The Ross-Moore sign was definitely positive. In the right lower extremity there was little if any demonstrable rigidity. The patient, however, was not able to use this extremity as one might expect; for instance, he could not raise the body on the toes of the right foot. The implication of this extremity was suspected because of a positive Babinski sign and an exhaustible ankle clonus. The right upper extremity was normal. The right Achilles reflex was increased. The patellar reflexes were approximately equal. In the upper extremities the reflexes were active on both sides. The left radial and triceps may have been slightly increased over the right, yet this was questionable and was found otherwise on a previous examination. The left handgrip was markedly weaker. The thenar eminence on the left was atrophied, the hand being of the simian type.

There was no bulbar paralysis nor any evident cranial nerve involvement. Both superficial and deep sensation were unaffected. The Romberg sign was negative, and coordination, except as interfered with by spasticity, was not affected. A roentgenogram of the cervical spine showed extensive hypertrophic arthritis of the cervical spine most marked at the fifth and sixth cervical segments. There was no evident encroachment on the neural canal.

Clinically, this case corresponds to those reported by Charles K. Mills under the caption of unilateral ascending and descending paralysis. I have observed two similar cases in the past year. The case presented is probably an atypical and slowly progressive form of amyotrophic lateral sclerosis.

Book Reviews

DISEASES OF THE NERVOUS SYSTEM. By H. CAMPBELL THOMSON, M.D., F.R.C.P. (LOND.), Physician to the Department for Diseases of the Nervous System, and Lecturer on Neurology, Middlesex Hospital; Physician to the Hospital for Epilepsy and Paralysis, Maida Vale; formerly Dean of the Middlesex Hospital Medical School. Third Edition Revised, with 11 Color and 12 Black-and-White Plates and 120 Figures in the Text. Price, $5.00. Pp. 547. New York: Paul B. Hoeber, 1921.

The author has set himself the difficult task of writing a "concise and yet readable" manual of nervous diseases for the use of students. In certain respects he has been signally successful, but there are a number of inadequacies and inaccuracies which cannot be overlooked. The book begins with a brief but well selected review of important anatomic and physiologic facts, followed by a description of the effects of lesions at various points and the tests by which these effects may be brought out clinically. The various diseases are then described separately, and this is made readable and concise by constantly referring the symptoms to the functional changes brought about by disease affecting various nerve paths. References to authorities are strikingly limited, with few exceptions, to English writers and, whether this is intentional or not, one feels that the text would be greatly improved by going further afield.

Among the defects which must render the work of less practical value for the student and general practitioner, special attention must be directed to the laboratory findings. A chapter is devoted to lumbar puncture and the spinal fluid but neither here nor in the detailed description of syphilitic affections is there any reference to the Lange test or the graduated method of performing the Wassermann reaction, and the description of cytological findings is extremely meager. Although a special chapter is devoted to the work of Orr and Rows on paths of infection, the descriptions of morbid anatomy are generally extremely vague, and there is a rather loose use of the terms sclerosis, degeneration, inflammation and congestion which must often leave the student wondering what it all means. In some instances the seat of the change is not given, notably in lethargic encephalitis, a chapter on this subject having been written for this edition.

A short chapter on tests for the examination of higher functions of the nervous system seems entirely out of place in a work of this kind. Here are mentioned, without sufficient detail to render them practically usable, reaction times, time discrimination tests, certain memory tests, word association tests and the psychogalvanic reflex.

The psychoneuroses are dismissed in a few words and with inadequate discussion. The author mentions in the preface to this edition that he has endeavored to bring the book up to date by including here special emphasis on disturbances in endocrine function. It would have been preferable to devote more space to the facts of the disorders. The deficiency here is particularly unfortunate when it is remembered that functional disorders are not only more frequent but also more amenable to treatment than organic diseases and that hence it is of the greatest importance that the student learn to recognize them early.

There are also not a few omissions from the symptomatology of organic diseases although, on the whole, these are well described. Thus, in tabes dorsalis there is no mention of the partial ptosis and enophthalmos which so often accompany miosis as evidence of sympathetic paralysis. Sixth nerve palsy as a common symptom of increased intracranial pressure is not given. In the list of types of headache, the indurative and psychoneurotic are omitted.

In spite of these defects and some errors in wording which should be corrected (for example, the statement that there is no "physiological connection" between neurons), the book is a distinct advance on many of the smaller textbooks, chiefly because it is something more than a mere compendium of symptoms. It is well printed and the illustrations are excellent.

PSYCHO-ANALYSIS OF THE "REFORMER." A Further Contribution to the Sexual Theory, by Joel Rinaldo, with a Preface by Andrew Tridon. Pp. 137. New York: Lee Publishing Company.

This is a screed against reformers and especially against prohibitionists by an avowed psychanalyst, apparently not a physician. That the author is a competent psychanalyst we greatly doubt. That he is superficial is obvious. To the reviewer the text smacks strongly of the product of one writing principally to turn out copy.

The argument is presented in the form of eight theses. A few of these will indicate its trend.

Second thesis: That the reformer is a hysteriac and that his social activities are the result of his abnormal condition.

Fourth thesis: That the reformer's hysteria results from an inhibition of normal sexual life and is a form of sexual perversion.

Fifth thesis: That prohibition is not essentially different from other reformist activities; that it is the result of sexual perversion and is a sadistic gratification of the sexual desire.

Sixth thesis: That the drinking of alcoholic beverages has a peculiar sexual significance and a necessary and important part in the healthy sex life of humanity.

A few discrete quotations may further indicate the character of the booklet.

"Reformism, however, is the expression of an abnormal psychic condition, and as such can be but an unnatural sexual gratification, antagonistic to the species; a perversion of the healthy sex life as complete and debilitating as sodomy or lesbian love.

"Constipation can then be admitted to account in part for the morbid psychology of the reformers, as a contributing factor, or aggravating reaction at least.

"Our first duty therefore is a liberation of sex from the taboos of custom and convention. It can only function normally if it is allowed to function freely in obedience to the laws of its own nature."

Unscientific, ill balanced writings like this serve only to bring into disrepute the work of serious men.

PATHOLOGY OF THE NERVOUS SYSTEM. By E. Farquhar Buzzard, M.A., M.D., F.R.C.P., Physician to St. Thomas' Hospital; and J. Godwin Greenfield, B.Sc., M.D., M.R.C.P., Pathologist to the National Hospital for the Paralyzed and Epileptic. Pp. 334. Price, 30 shillings. London: Constable and Company, Ltd.

This work is just what it obviously aspires to be: a safe and sane guide for "students and practitioners" in the pathology of organic diseases of the nervous system. We should be inclined to insert "general" before "practitioners" because none of the articles is sufficiently detailed for the expert, and there is practically no discussion of the many mooted points in this field. Indeed, in the broad sense the work is not at all a treatise on pathology of the nervous system; it is rather a handbook of pathologic anatomy. For instance, there is nothing on the pathology of aphasia and apraxia, of vertigo, of conjugate deviation, of the Argyll Robertson pupil, of the automatic bladder, of convulsions and a thousand other things in the pathology of the nervous system.

After an excellent chapter (49 pages) on the general pathology of the nervous system and its constituents (neuron, neuroglia, paths of infection, cerebrospinal fluid), the authors discuss the developmental and familial diseases, injuries to the nervous system, circulatory disturbances of the brain and spinal cord, syphilis of the nervous system, other infective diseases, effects of poisons, tumors of the brain and spinal cord, and diseases of obscure origin. In the last category are motor neuron disease (progressive muscular atrophy, amyotrophic lateral sclerosis and bulbar palsy), subacute combined degeneration of the cord, multiple sclerosis, syringomyelia, paralysis agitans and myasthenia gravis. An appendix on staining methods follows, only sixteen pages long but quite adequate; there is another appendix on methods of examination of the cerebrospinal fluid.

Although there is no exhaustive study of the pathologic anatomy of any disease, no important disease is omitted, and the presentation of attendant changes is remarkably satisfactory considering its brevity. In addition to pathologic anatomy, etiology and pathogenesis frequently are discussed, of course with advantage to the reader.

It must be added that while the matter is quite up to date, the authors have avoided all novel fads and fancies, showing that judicial mind and conservative attitude so valuable, nay necessary, in a textbook. The style is simple and direct, the text always clear, as are also the 103 figures. The book is handy in size and in contents; a reliable and pleasing guide for the student, valuable for the internist and to be taken seriously by the specialist.

THE SCIENCE OF OURSELVES (A Sequel to the "Descent of Man"). By SIR BAMPFYLDE FULLER, K.C.S.I., C.I.E., Author of "Studies of Indian Life and Sentiment," "The Empire of India," "Life and Human Nature," and other works. Cloth, $6.50. Pp. 326. London: Henry Frowde, Hodder & Stoughton, 1921.

The aim of this volume is to "set out an inferential theory which will explain the origin and course of feeling, thought and behavior—an undertaking which must fall short of full achievement." One can deal statistically with the perceptible consequences of loyalty and disaffection, of industry and idleness, but the author's aim is by "reasoning inference" to detect the causes from which such consequences spring.

The table of contents falls into two parts: the first under the title "Nervous Activities," and the second under that of "Motives and Behavior."

We are affected by three kinds of motor excitement: one of the "physical nervous system," another of the "psychic" and the third of the "brain." Whatever this may mean to the author, it is dense from the point of view of a student of psychology. And again, "A recollection is a record of the character of a sensation." And further, "Since *consciousness is pleasure or displeasure* its effect is to reduce different impressions and recollections to a common denominator and so render them comparable." It is astonishing to the student of psychology to find consciousness so easily defined.

Concepts are complex ideas.

In the chapter on "Thought and Muscular Movement," in which one would expect to find some meat from an author who claims to rest his work on the "basic facts that physiologists have wrung from nature," we read: "Muscular movements are primitively either instinctive reflexes, automatic expressions of feeling, or efforts of trial. The first are purposeful or practical and being instinctive, are stereotyped. The second are more or less plastic.. The third are free and therefore entirely plastic and may take either a practical or an emotional character."

The title, "The Science of Ourselves," would lead one to look in this volume for a description of the self. The one who expects this will put the book aside disappointed.

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A RECONSTRUCTION COURSE IN THE FUNCTIONAL ANATOMY OF THE NERVOUS SYSTEM *

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The method to be described has been gradually adapted to the needs and demands of physicians and medical students alike, both groping for a clearer and more plastic conception of the nervous system. The underlying principles have been embodied in a course in neuro-anatomy which translates all facts into three dimensions and so incorporates ontogenetic and phylogenetic studies as to help the worker mold his data in a perspective which is thoroughly dynamic. The result is a sound, practical and tangible working basis for the application of the facts as they are experienced.

Since 1893, when Prof. Donaldson granted him the privilege of conducting an elective course in the comparative anatomy of the nervous system at the University of Chicago, and two years later also the regular course in brain anatomy at that institution, Dr. Meyer has had the opportunity from time to time of giving students of greatly varied preparation a review of the essentials and methods of study of the nervous system. The first printed statement appeared in 1898 as part of a review[1] of the neuron doctrine. In it Dr. Meyer presented his plan of the nervous system, which was the outgrowth of his first researches on the forebrain of reptiles and his study of the work of the great English neurologist, Hughlings Jackson, who, in the formulation of his three-level theory, shaped a new and bigger perspective for the neurologist's needs.

Dr. Meyer's duties at the New York Institute forced him to formulate a course for State Hospital physicians, in which an attempt was made to embrace the method of glass-plate reconstructions and the use of plasteline, so as to render the facts convertible into three dimensions,

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* Read at the Forty-Seventh Annual Meeting of the American Neurological Association, Atlantic City, N. J., June, 1921.

* From Phipps Clinic, Johns Hopkins Hospital.

[1] Meyer, Adolf: Critical Review of the Data and General Methods and Deductions of Modern Neurology, J. Comp. Neurol. **8**:3-4, 1898.

thereby insuring the acquisition of data in a controllable form. In the meantime, Dr. Oliver Strong used these conceptions in his courses laid down in Bailey's "Text-Book of Histology." Finally, at the Johns Hopkins Medical School, the opportunity presented itself of reaching medical students and graduate workers who were willing to lay their anatomic foundations in this way. During this last year two groups, one of fifty second-year and another of sixty-three first-year students, called for this elective work, and, with the collaboration of Dr. Louis Hausman, the course was given the form we wish to sketch here. Each student made a model—the only way to offer a basis of discussion of difficulties or errors. Each course covered two forenoons a week for a trimester, with one-half to one hour devoted to conjoint discussion and demonstration and the rest to individual work on the models and drawings.

The underlying pedagogic principle is not to allow the worker to think of, talk of or work with, anything that is not clearly established and connected in his own experience. It embraces the data and methods of comparative anatomy, embryology, physiology and experimental and pathologic anatomy. It utilizes nature's experiments in the study of the secondary and experimental degenerations, culminating in a conception of the integration of the nervous system, which, at all times, is readily adaptable to the needs of any situation. By getting away from a burdensome terminology and from endless detail, and by teaching him to work unyieldingly with the facts he can grasp and put together into a practical whole, the student is emancipated from the chaotic and bewildering task usually forced on him, as he is required to combine and survive the diverse teachings of the different courses in his training.

An element of pedagogic philosophy underlies the principle. At no time is the student permitted to lose the view of the whole living biologic organism. Facts and functions must be the issue of the course, not words. Books and written instructions are avoided. Actual material of embryology and comparative neurology furnish all the schemata that are needed; all other schemata are taboo. We begin at once with the individual as we see him and review from head to foot the anatomic parts, as they have to work together in groups; thus is embraced a rational system of segmental or reflex units which the nervous system has to integrate into a personality.

The body is readily viewed as a series of transverse body-segments, held together by a neural tube and ganglion chain, with the following longitudinal arrangement: (1) ventrally the motor-plate, (2) dorsolaterally the receptor-plate, and (3) most dorsally—the roof structures furnishing the later acquisitions. Thus we find a reasonably correct and simple scheme of transverse and longitudinal groupings, forming a division of the nervous system into two essential mechanisms: segmental and suprasegmental; the former with its intrasegmental and intersegmental components constitute the basis for all reflex activity, whereas the latter, being a later and more specialized development of the intersegmental provisions, meets the needs of economy by centralizing the equilibratory (both static and kinetic) and affective functions, and also the psychobiologic functions, that is, the working together of our cognitive and intellectual resources and the activities largely of the striped muscle system—the whole making up the personality.

By keeping before our eyes the segments of the body and the transverse and longitudinal subdivisions of the neural tube, we obtain an easily remembered rack on which to hang all other data (Fig. 1).

We first consider the divisions of the neural tube and ganglions in the His-models (Fig. 4) and observe the enlargements and transverse constrictions of the tube, giving us the cord, the HB (hindbrain), MB (midbrain) and FB (forebrain). Similarly we recognize in a longitudinal plane (Figs. 2 and 3):

1. The motor or effector plate with its roots, extending to the cephalic end of the MB.
2. The receptor plate and its roots.
3. The dorsal structures, developing the roof membranes and suprasegmental mechanisms.

Then, turning to the body, we group the muscles and viscera and the sense organs into segments (Fig. 1):

1. The olfactory apparatus.
2. The eye socket and its contents.
3. The jaws forming the mastication and gasserian segment, with its peripheral and central distributions.
4. The ear with its vestibular and cochlear apparatus and the intermediate-facial-abducens group.
5. The taste, deglutition, articulation and thoracic and abdominal visceral segment.
6. The cervical, thoracic, lumbar, sacral and coccygeal segments.

Having recognized these divisions of the body and neural tube, the next logical step is to correlate them (Fig. 1): The olfactory and optic mechanisms form the foundation of the forebrain and midbrain; the isthmus corresponds in the face to the lower orbital edge, marking roughly the limit between the midbrain and hindbrain; the mastication and the auditory-facial-abducens and the taste-deglutition-respiration-articulation segments, respectively, form the anterior, middle and pos-

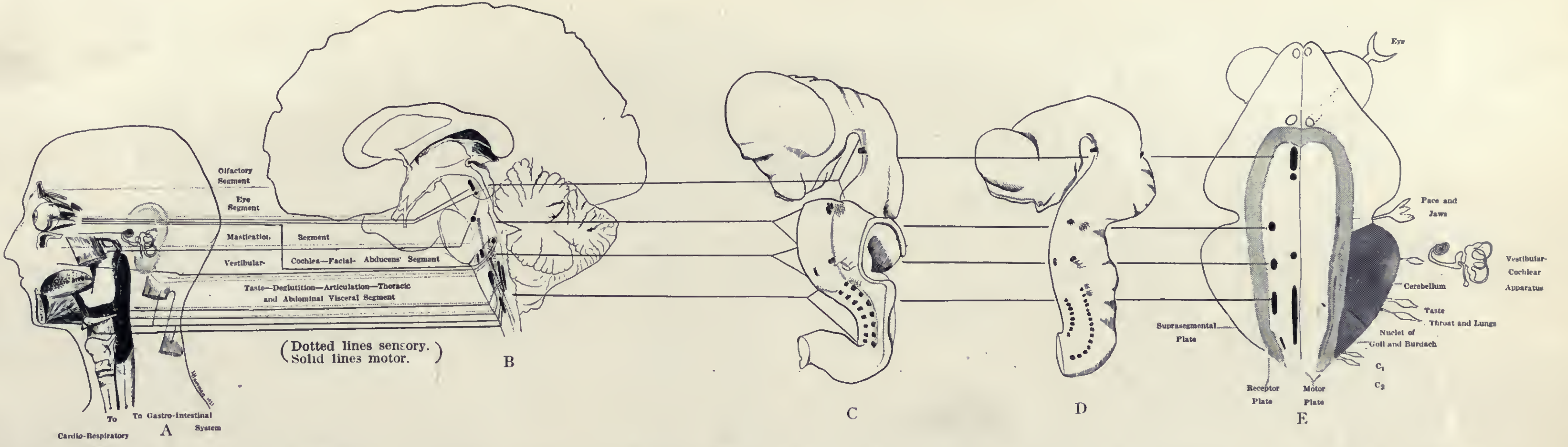
Olfactory Segment
Eye Segment
Mastication Segment
Vestibular- Cochlea—Facial- Abducens' Segment
Taste—Deglutition—Articulation—Thoracic and Abdominal Visceral Segment
(Dotted lines sensory. Solid lines motor.)
To Cardio-Respiratory System
To Gastro-Intestinal System
A
B
C
D
E
Eye
Face and Jaws
Vestibular-Cochlear Apparatus
Cerebellum
Taste
Throat and Lungs
Nuclei of Goll and Burdach
C_1
C_2
Suprasegmental Plate
Receptor Plate
Motor Plate

Fig. 1.—*Correlation of Segments.* The motor nuclei and efferent nerves are in solid black; the receptor nuclei are dotted and the afferent nerves outlined. *A,* the segments as they can be read off from the body. *B,* median sagittal section of an adult brain with the nuclei of the midbrain and hindbrain represented on one plane. *C,* left lateral view of the brain of a human embryo about 5 weeks old (13.6 mm.), after a His model. The segmental arrangement is very apparent. The motor and receptor plates are well defined and separated by a slight groove in the hindbrain. The motor plate mesially presents the oculomotor nerve in the midbrain—the trochlear nerve appearing dorsally after decussating in the roof, the abducens in the middle hindbrain and the hypoglossal in the posterior hindbrain segment; laterally the trigeminal in the anterior hindbrain, the facial in the middle hindbrain and the glossopharyngeal, vagus and spinal accessory roots in the posterior hindbrain. In the receptor plate are seen the afferent roots of the trigeminal in the anterior hindbrain; the nervus intermedius (or the afferent fibers of the facial nerve) and the vestibular and cochlear nerves in the middle hindbrain, and the afferent fibers of the glossopharyngeal and vagus nerves in the posterior hindbrain. *D,* brain of human embryo (10.2 mm.) after a His model. The segmentation is even more clearly defined than in *C,* due to the fewer bendings of the neural tube. *E,* primitive neural tube opened up and spread out on one plane. Situated mesially in the motor plate from above down are the oculomotor, trochlear, abducens and hypoglossal cell clusters or nuclei; laterally, the trigeminal or mastication, facial and ambiguus nuclei. The receptor plate presents the trigeminal complex, the tractus solitarius with its nucleus, and the vestibular cell-mass.

terior hindbrain segments and the foundation for the cerebellar apparatus; the cord segments are clearly marked by roots and intercostal and equivalent subdivisions of the body (Fig. 3).

This correlation is further enhanced and simplified if we study the neural tube from the inside out, that is, from the ventricle outward. Thus we are readily enabled to establish a direct relation between the neural tube and what we see in every living patient—a relation to muscle groups and viscera and sense organs and sensory surfaces. Each segment of muscles and glands has its efferent or effector provisions which are played on by definite afferent elements, connected with segmentally arranged sense organs; these effector and receptor ele-

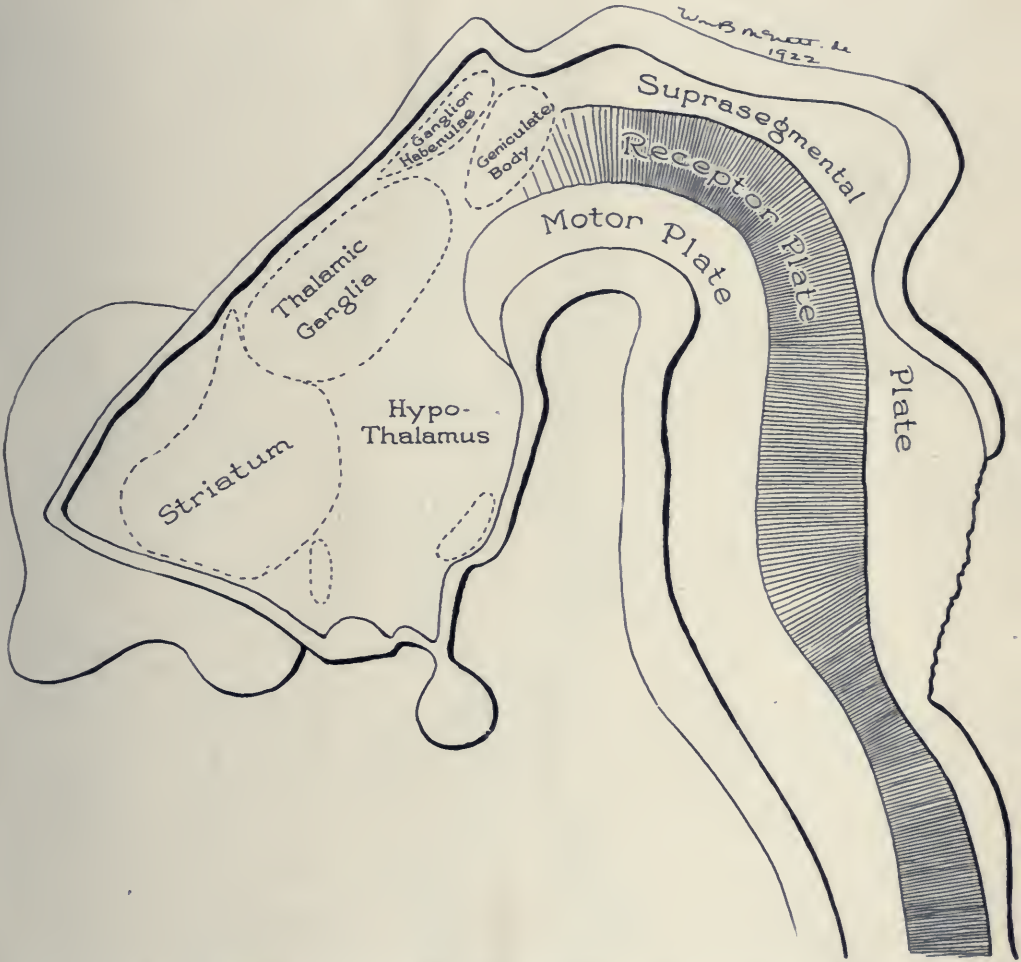

Fig. 2.—Median section through embryo human brain. (After a His model.)

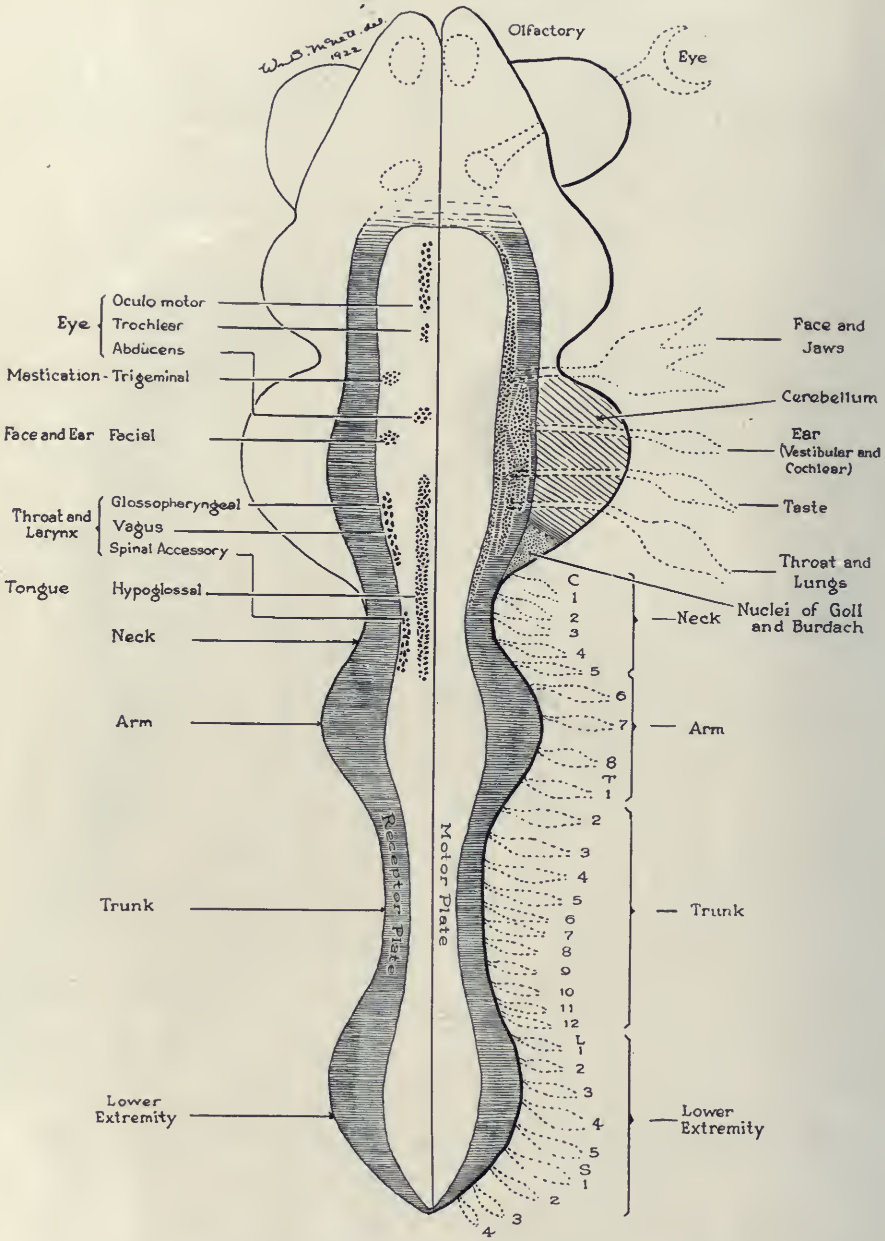

Fig. 3.—Scheme of primitive neural tube opened up, with the various parts represented on one plane.

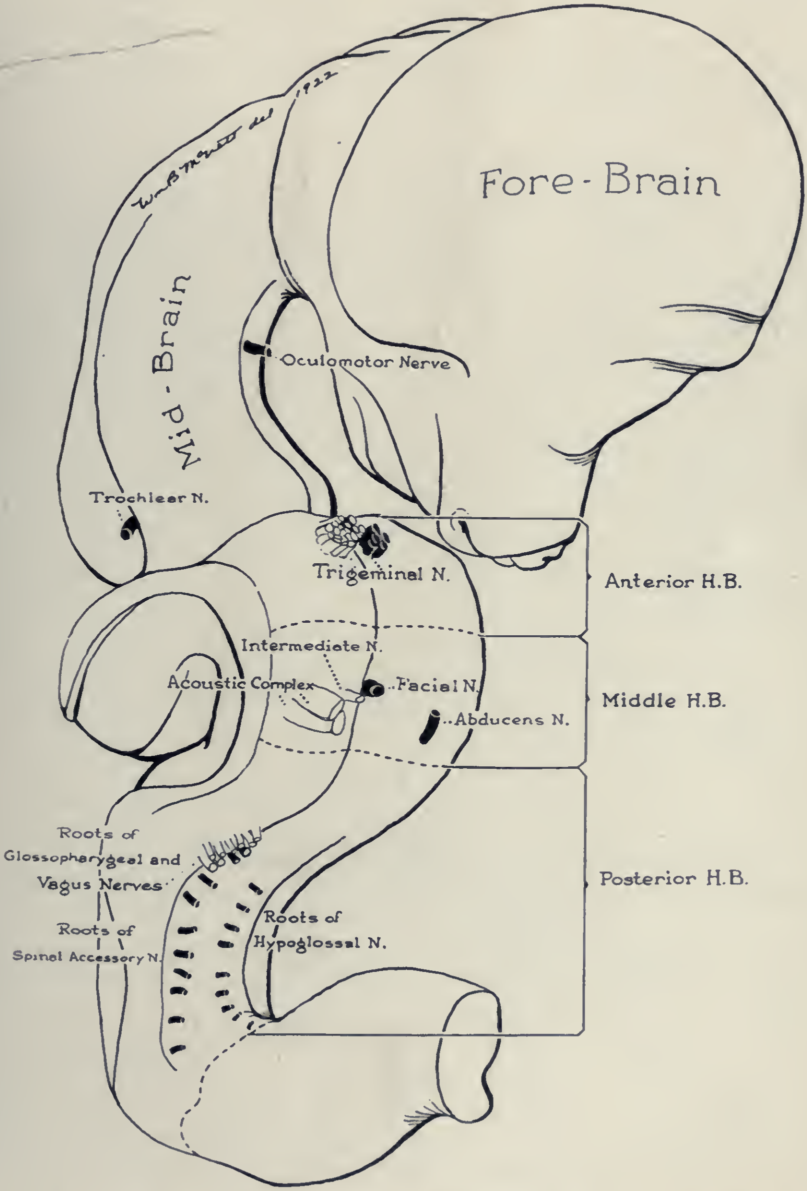

Fig. 4.—Brain of a human embryo 5 weeks old (13.6 mm). (After a His model.)

ments, which the neural tube presents, are in turn coordinated by intrasegmental and intersegmental components, the ultimate integration of these various parts being achieved by the suprasegmental cerebellar and cerebral mechanisms. Whatever is added to the simple segmental stage grows on the outside (Fig. 5). That is why we begin with the simple neural tube and work from the ventricle outward, instead of beginning with the "pons" and other late surface additions and working backward; the former approach is simpler and more logical. Therefore we start with the segmental parts. The open tube (Fig. 3) gives the fundamental scheme.

We resolve the tube into its various elemental mechanisms by experimental analysis and to that purpose employ the Gudden, Nissl and Wallerian types of degeneration of the peripheral or root elements to establish the actual segmental mechanisms. Further analysis identifies the ground bundles and reticular substance of the tube as the intersegmental elements. The dorsal excrescences or terminal bulgings of the tube form the suprasegmental organs: (*a*) the cerebellar organ; (*b*) the midbrain roof organs, and (*c*) the forebrain.

Extirpation of a suprasegmental organ singles out in each segment (*a*) the cells of the suprasegmental afferent neurons by the axonal reaction and atrophy, and (*b*) the suprasegmental efferent fibers by outgoing degeneration. These experimental principles are always kept in view, since they give us the objective definition of what we work with. For the reconstruction of the segmental apparatus the reader should consult Figures 6 to 9, inclusive.

SUPRASEGMENTAL ORGANS

As we ascend the vertebrate scale, we find that the pattern of the neural tube becomes more and more differentiated; the nervous architecture takes on various designs; we note that the differentiation runs parallel with the behavior resources of the organism as we get further away from the simple reflex type of the more or less segmental animal.

In the process of evolution, economy develops specialized organs, that is, the suprasegmental structure for the centralizing of definite types of function of the segmental animal. The lack of such economy and centralization would provide a system entirely too cumbersome for the needs of man for prompt activity. In the amphioxus, for example, there are, according to Kölliker,[2] twelve large cells in the cranial part sending fibers to the more caudal segments, and fourteen similar cells in the caudal segments sending their fibers to the cranial part. For the complex correlations in man, innumerable connections of this type

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[2] Kölliker: Handbuch der Gewebelehre des Menschen, 1893.

would be needed between the head, neck, trunk and lumbosacral segments; the tube would be encumbered and the time of interaction too slow. Instead of this pattern, we find added to the simple reflex segmental components, the suprasegmental structures:

1. The cerebellar station with its afferent elements from the segments and efferent paths carrying to these segments the net result of cerebellar synthesis—that is, the elaboration of all the equilibration and balancing functions of motility.

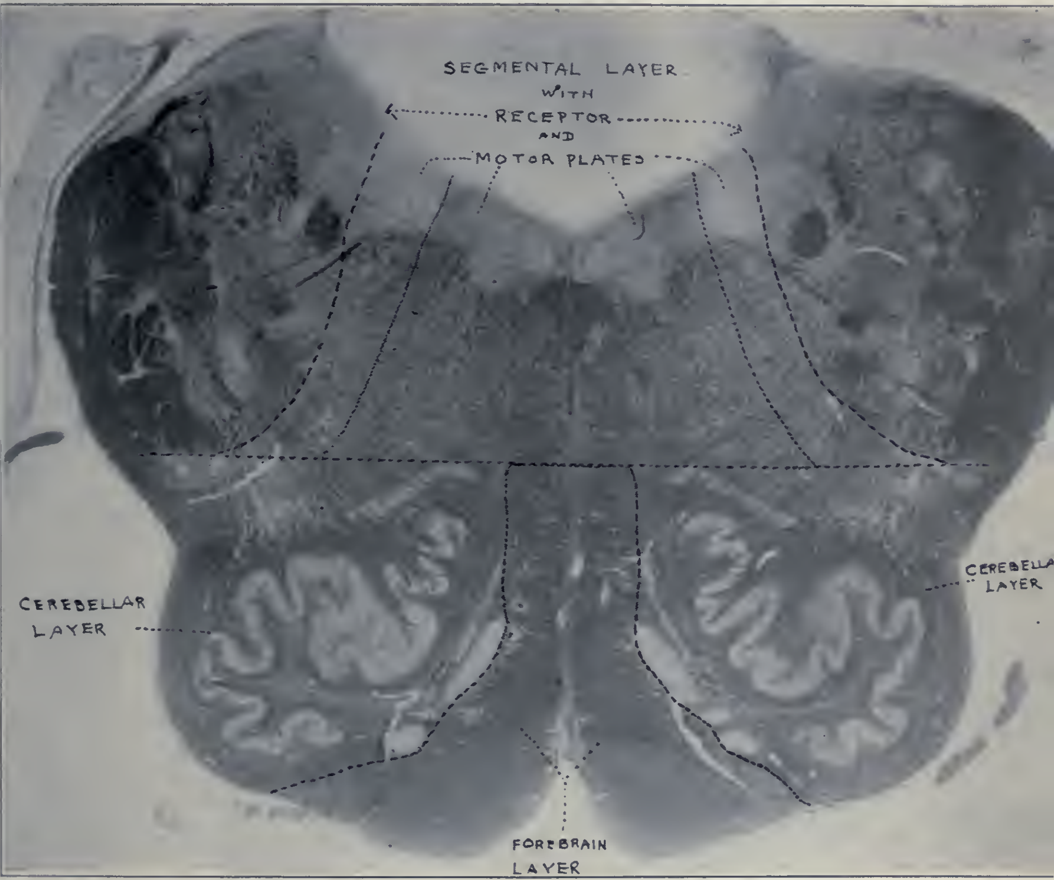

Fig. 5.—Photograph of a cross-section through the posterior hindbrain segment of an adult brain, showing from within out—the segmental layer with its motor and receptor plates, the cerebellar layer and finally the forebrain layer with its afferent and efferent components. (Weigert stain.)

2. The colliculi, belonging to the midbrain and highly developed in the lower animals, with their afferent and efferent mechanisms.

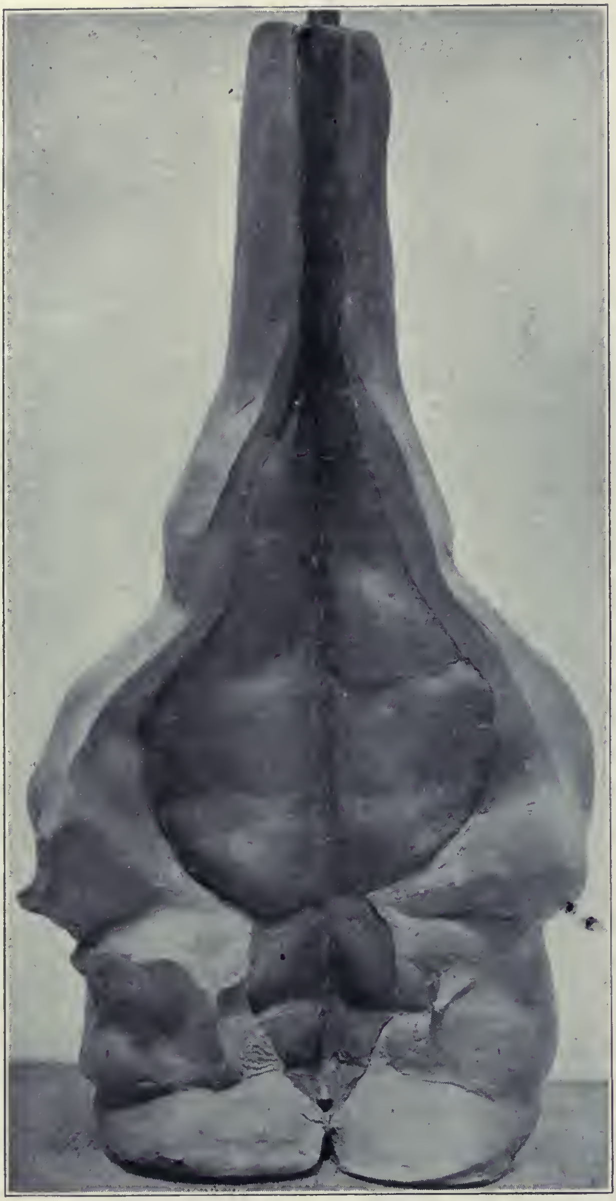

Fig. 6.—*Dorsal View.* Reconstruction of the segmental plates of the midbrain and hindbrain, viewed from within the hindbrain ventricle, at the base of which the spinal canal is seen opening into it. Note the marked narrowing of the plates toward the cephalic limit of the midbrain and the extent to which the receptor plates overlap the motor. Owing to the marked flare of the receptor plates in the middle hindbrain segment, the ventricle is broadest at that level. Immediately below this flare, on either side, are seen the projections for the attachment of part of the choroid plexus. Reduced from photograph × 4.7.

3. The forebrain apparatus, for the coordination and central elaboration of all the conditions of psychobiologic functions.

Cerebellum.—Embryology shows us how and where to add the cerebellar organ. This suprasegmental structure, developing dorsally over the vestibular and trigeminal segments, consists of a terminal

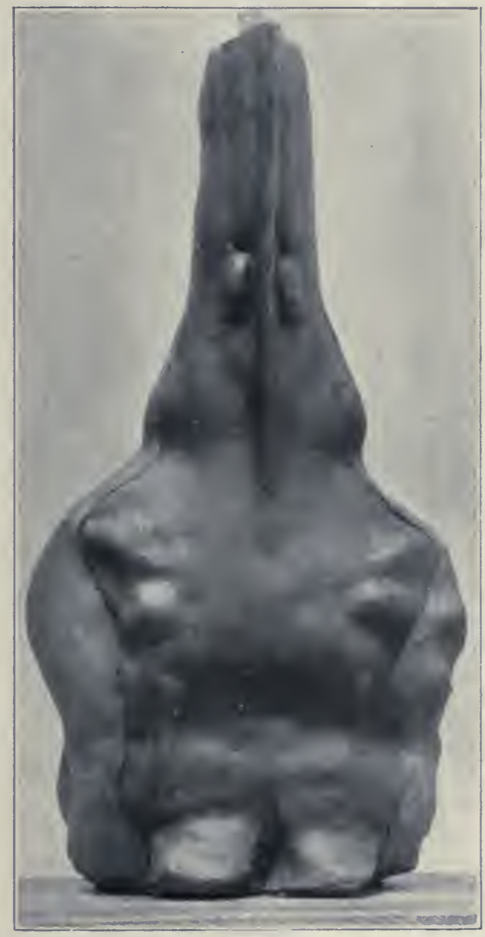

Fig. 7.—*Ventral View of Figure 6.* The motor and receptor plates, showing the additional reconstruction of the nuclei which appear on the ventral surface of the former. In the mesial part of the midbrain, the motor plate, containing the oculomotor and trochlear nuclei, forms a beak-like projection which gradually disappears in the anterior hindbrain segment. In the lateral part of the motor plate, we recognize, from above down, the trigeminal or mastication nucleus in the anterior hindbrain segment, the facial nucleus in the middle hindbrain segment and the slender ambiguus nucleus for the glossopharyngeal, vagus and accessory nerves in the posterior hindbrain segment. The ventral horns at the base mark the transition of the motor plate of the spinal cord into that of the hindbrain; × 2.8.

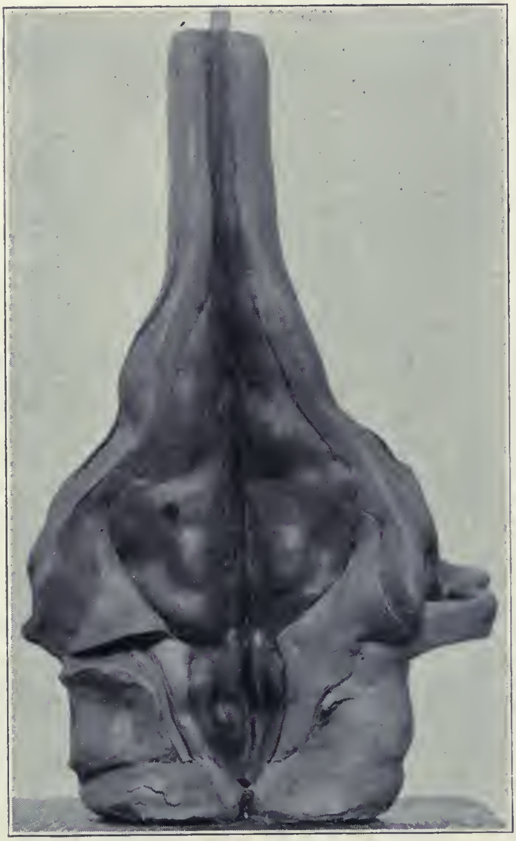

Fig. 8.—*Dorsal View.* Reconstruction of the segmental cell groups appearing in the dorsal part of the motor and receptor plates.

The motor plate presents mesially from above down the round abducens nuclei in the middle hindbrain and the slender hypoglossal nuclei occupying the greater part of the posterior hindbrain segment, in the lateral portion of which is seen the dorsal preganglionic sympathetic nucleus, lying adjacent to the receptor plate.

The right receptor plate presents the large vestibular cell-mass in its entire length and the cochlear complex which juts off perpendicularly to allow sufficient space for the restiform body to pass through (Fig. 15).

In the left receptor plate, the caudal portion of the vestibular mass has been cut away to show the course of the elongated tractus solitarius.

The groove in the anterior hindbrain and midbrain segments indicates the path of the mesencephalic root of the trigeminal, which can be seen more clearly in Figure 10.

The descending or spinal root of the trigeminal being situated in the ventral part of the receptor plate adjacent to the motor (Fig. 11) is not seen in this figure; × 2.6.

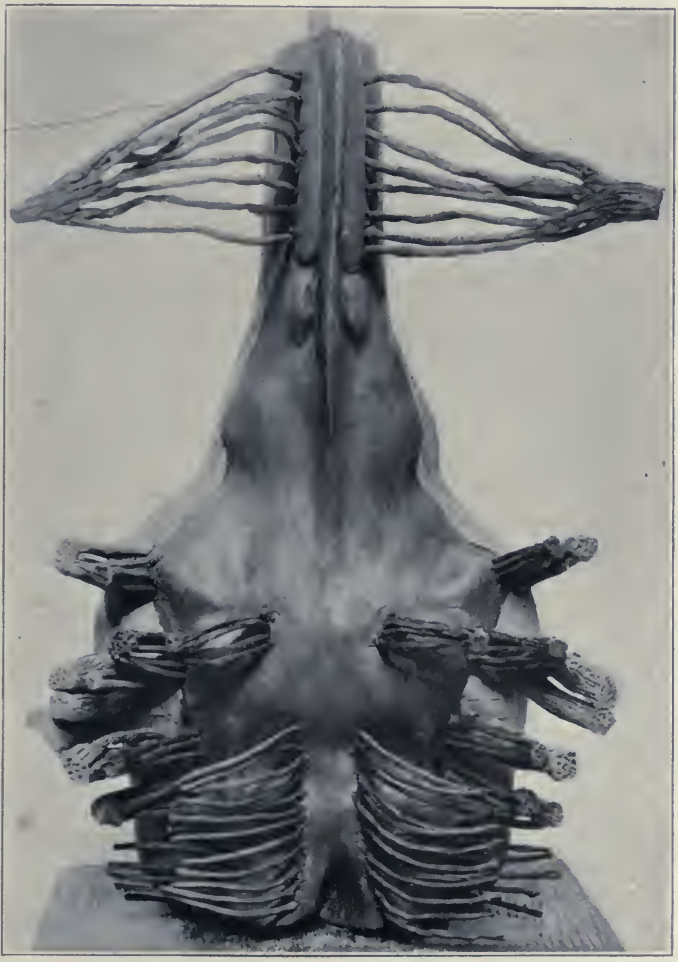

Fig. 9.—*Ventral View of the Segmental Nerve Roots.* The motor plate presents from above down and in the midline the nerve roots of the oculomotor nerves in the midbrain, the abducens nerves in the middle hindbrain and the numerous hypoglossal filaments in the posterior hindbrain segment, occupying the greater part of its length; laterally appear the trigeminal roots of the mastication nucleus in the anterior hindbrain, the facial roots in the middle hindbrain, and the glossopharyngeal, vagus and accessory fibers in the posterior hindbrain segment. The receptor plates present in the anterior hindbrain the afferent roots of the trigeminal, in the middle hindbrain the nervus intermedius and the vestibular and cochlear nerves, and in the posterior hindbrain segment the afferent components of the glossopharyngeal and vagus nerves.

The trochlear nerve by reason of the unique course it follows in passing through the substance of the segmental plates to decussate dorsally in the anterior medullary velum is not shown in this stage of the reconstruction, but can be seen in Figure 16, emerging beneath the inferior colliculus. × 3.

sheet (of cortex) and central ganglions. The pons mass and the inferior olives, which are so intimately associated with it, have wandered from the lip structure to the ventral side of the motor plate (Fig. 5). Thus we have these parts: arising over the vestibular cell-mass the "inner cerebellar arm" with the roof nucleus (Fig. 10); outside of this fundamental arch the dentate nuclei (Figs. 11 and 12) giving off the superior cerebellar arms, and the intermediate nuclei (globosus and emboliformis) lying between the dentate and inner arm (Figs. 11 and 15); the restiform bodies swinging around the dentates, conveying from the segments the bulk of the afferent fibers to the vermis (Figs. 14 and 16), that is, the cerebellar cortex. This terminal sheet of the cerebellum consists primarily of vermis and flocculus (Fig. 15) and later of the more recently developed cerebellar hemispheres, which are reached by the pons arms; that the latter are the most superficial of the cerebellar peduncles, coincides with the fact that they are the last to develop, their development running parallel with that of the opposite cerebral hemisphere.

This sketch of the cerebellar apparatus gives the rack within which to study the histologic details and the results of genetic and experimental work. The elimination of the cerebellum in the young leads to atrophy of all the cerebellar afferent cells and fibers united in the restiform complex: the Clarke column cells and direct spinocerebellar tract, fibers from the posterior column nuclei, and the fibers from the opposite inferior olive (Figs. 13, 14 and 16). Fibers from the lumbar region form the ventral cerebellar tract swinging around the trigeminal root and thence over the superior cerebellar arm to the vermis (Fig. 16).

The cerebello-segmental impulses have several outlets. One set is affected by the cerebellar cortex activity through the roof nuclei and the inner arm, finally reaching the segments through the vestibulo-ocular or vestibulo-cephalic tract (the mesial longitudinal fasciculus) and the vestibulo-spinal tracts (Figs. 11, 13 and 15). Another outlet is formed by the superior arm to the opposite red nucleus, influencing the segments through the rubrospinal pathway (Figs. 17 and 18), and the cerebral basal and cortical mechanisms through the rubrothalamic elements. A third cerebellar efferent path is the hook bundle to the tegmentum of the hindbrain.

The great variations of the cerebellar mechanisms in the animal series make it obvious that the term "pons" should not be used for the designation of the tegmentum and the segments of this region. It refers purely to the neocerebro-neocerebellar connection which forms the ventral superficial protruberance. All these parts are built on the outside of the original segmental parts. The reconstruction of the cerebellar apparatus is presented in Figures 10 to 18 inclusive.

Midbrain.—The midbrain, originally the dominant integrator of all receptor functions, presents in its roof the auditory colliculi and the optic colliculi resting on the midbrain nucleus of the trigeminus (Figs. 14, 15 and 16). The auditory or inferior colliculus receives the lateral fillet, which is the upward continuation of the trapezium or auditory decussation (Figs. 17 and 18). The optic or superior colliculus in-

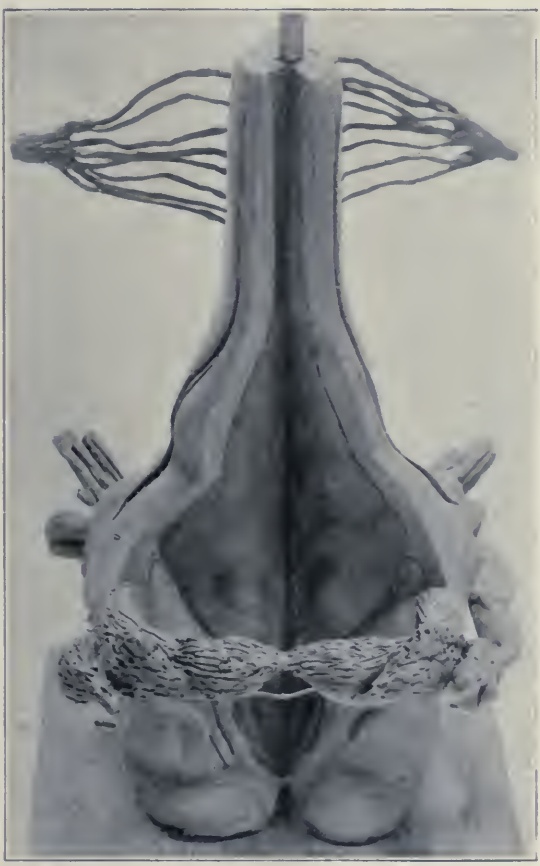

Fig. 10.—*Dorsal View Slightly from Above.* Fundamental arch of the cerebellar reconstruction, showing the inner cerebellar arm arising from the vestibular mass on either side to terminate in the cells of the mesially placed roof nuclei. Resting on the inner arm and lateral to the roof nuclei are the intermediate cell groups (globosus and emboliformis); these parts are also to be seen in Figures 11, 12 and 15.

The efferent mechanisms associated with the inner cerebellar arm (the posterior longitudinal bundles and the vestibulospinal systems) can best be seen in Figures 11 and 13. × 2.5.

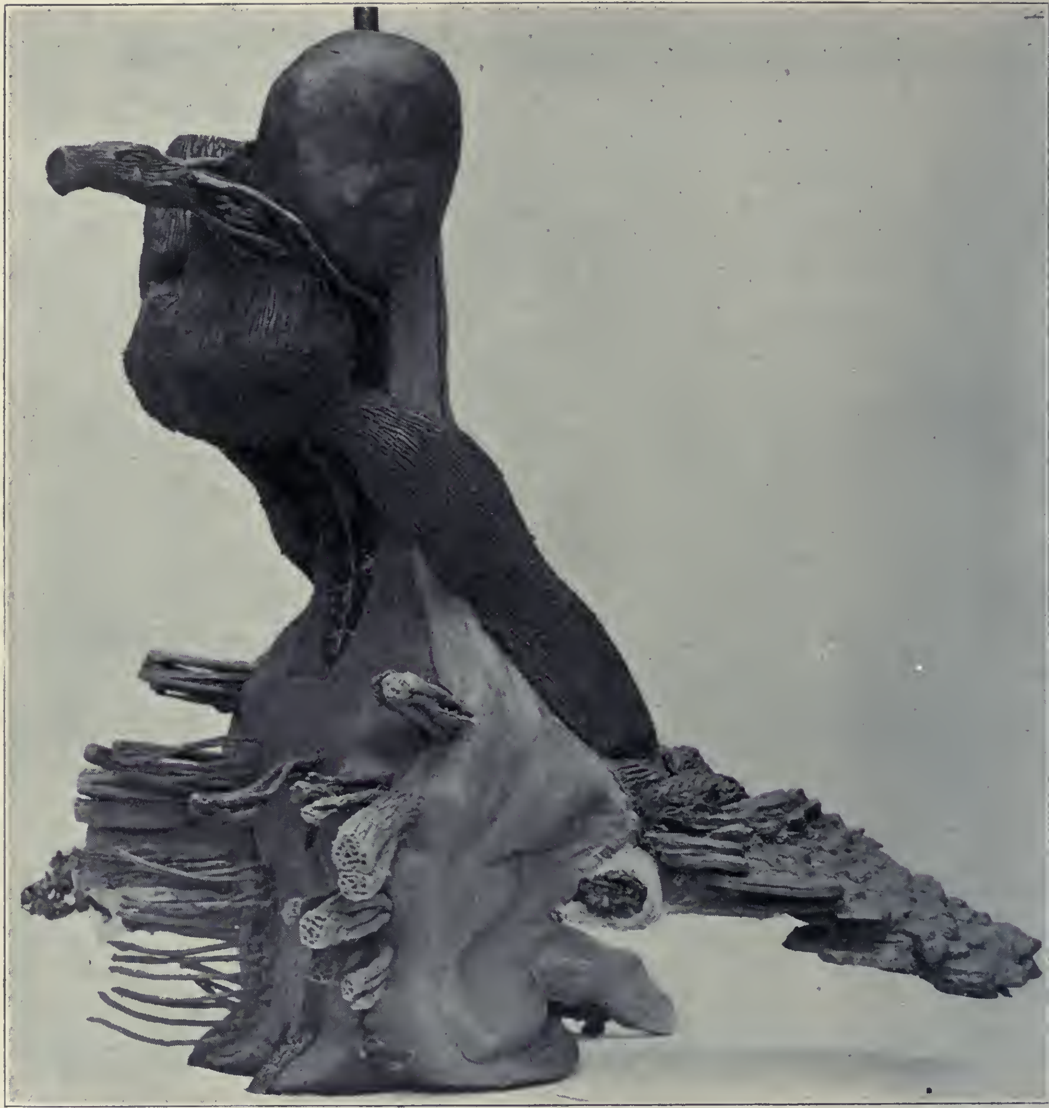

Fig. 11.—*Left Ventrolateral View.* Reconstruction of the superior cerebellar arm, showing the cell-mass of origin (dentate nucleus) and the course of the cell processes as they pass toward the midbrain to decussate (at the level of the trochlear nuclei and ventral to the motor plate) before entering the red nucleus, which has been reconstructed only on the left side of the model; the fibers entering the red nucleus form a distinct shell, which is quite thick on the ventromesial surface (Fig. 15).

Note the posterior or mesial longitudinal bundles which are seen only on the upper part of the motor plate; in the hindbrain they occupy a dorsomedian position and therefore are not seen in this part of the reconstruction. In the lower part of the motor plate the vestibulospinal systems are readily recognized. × 3.2.

fluences the lower segments of the neural tube through the colliculospinal (or predorsal) bundle (Figs. 17 and 18). For the reconstruction of the midbrain consult Figures 14 to 18, inclusive.

Forebrain.—The forebrain is divided into the median line and lateral wall structures, the former presenting the posterior commissure, the pineal recess and pineal gland, the superior or habenular commissure, the taenia and roof membrane with choroid plexus, the neuropore region, anterior commissure, lamina terminalis, optic recess and chiasm, infundibulum and pituitary body, tuber cinereum and saccus vasculosus region, and the mamillary region and interpeduncular ganglion. The lateral walls consist of the thalami (with the obliterated eye protrusion) and the olfactory protrusion, carrying also the striatum and the hemisphere cortex.

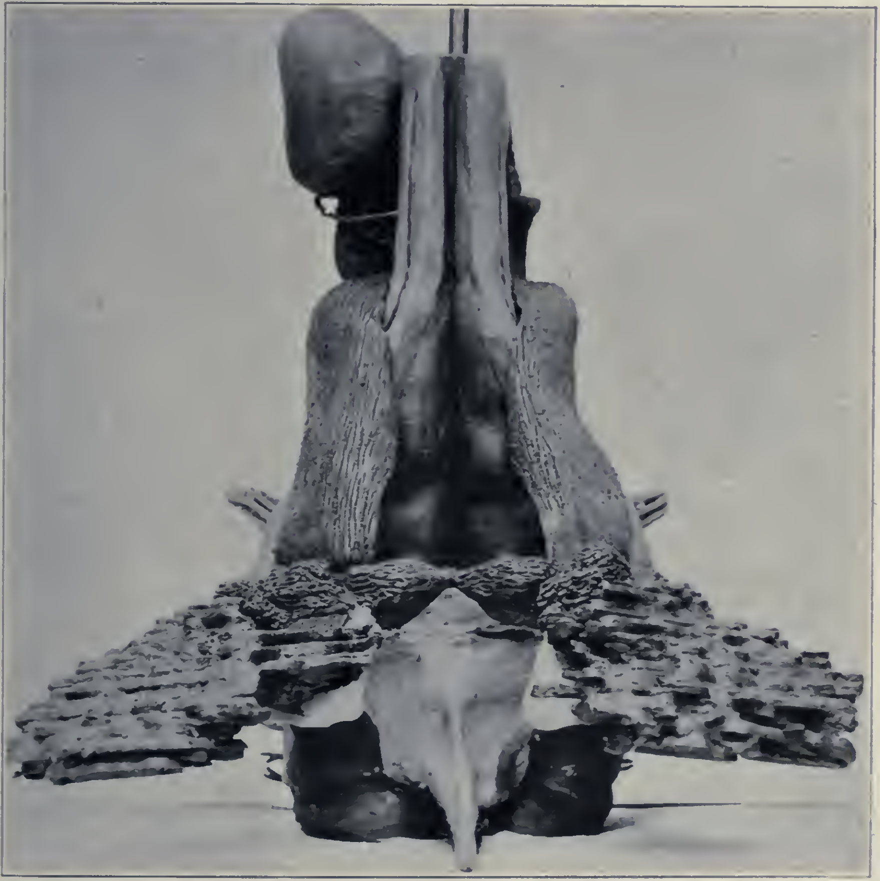

Fig. 12.—*Dorsal View of Figure 11.* The posterior medullary velum (in white) has been added. × 2.5.

The construction of the forebrain rests on the midbrain and brings out:

1. The hypothalamus and floor of the median forebrain ventricle (or third ventricle), with the infundibulum, tuber cinereum, corpus mammillare, the hypothalamic nucleus (corpus Luysii) and the substantia nigra.

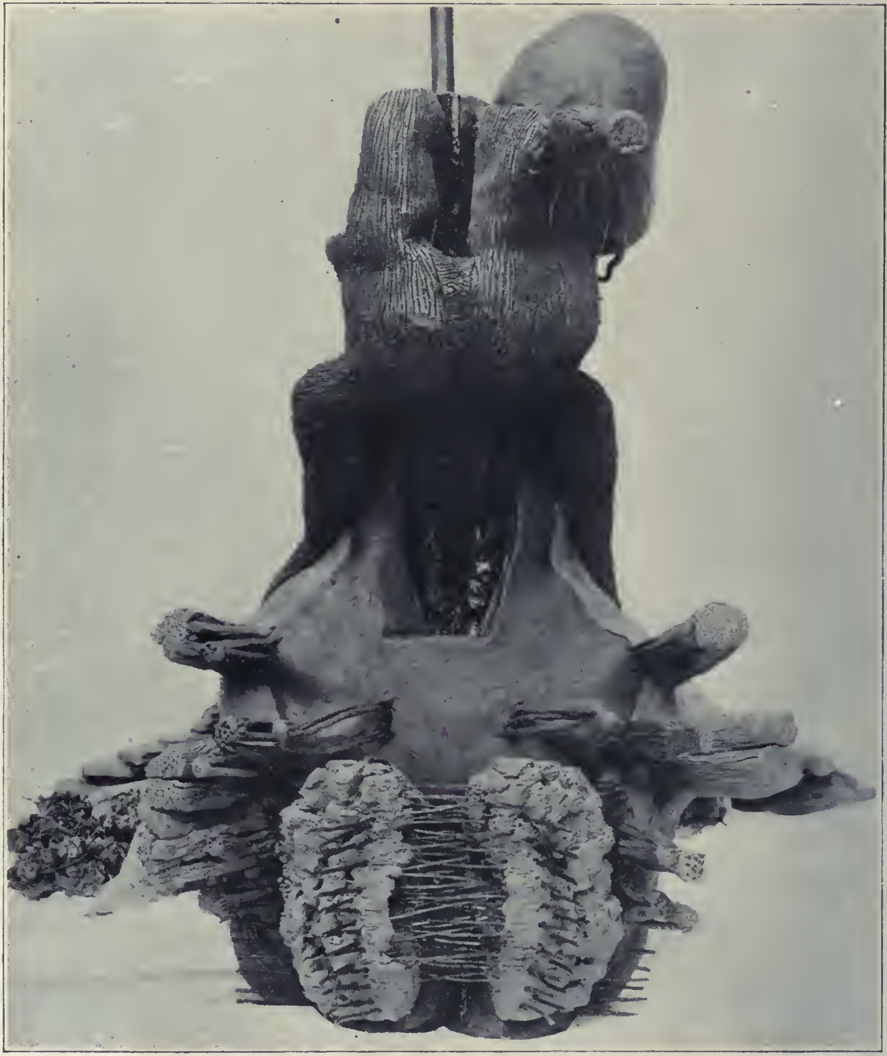

Fig. 13.—*Ventral View.* Beginning of the reconstruction of the inferior cerebellar arm or restiform body. The inferior olives with the interolivary and olivocerebellar fibers are shown. Note the relation of the hypoglossal roots to the olives. On the right, immediately adjacent to the acoustic and glossopharyngeal nerves, the lateral pocket with its choroid plexus is seen. × 3.1.

2. The thalamus thickness proper: the anterior, median, lateral, dorsal, central and posterior nuclei (pulvinar and geniculate bodies), and continued posteriorly, the red nucleus.

3. The epithalamus: taenia, ganglion habenulae, superior commissure and the retroflex bundle to the interpeduncular ganglion, which in turn is connected with the central gray of the anterior hindbrain segment.

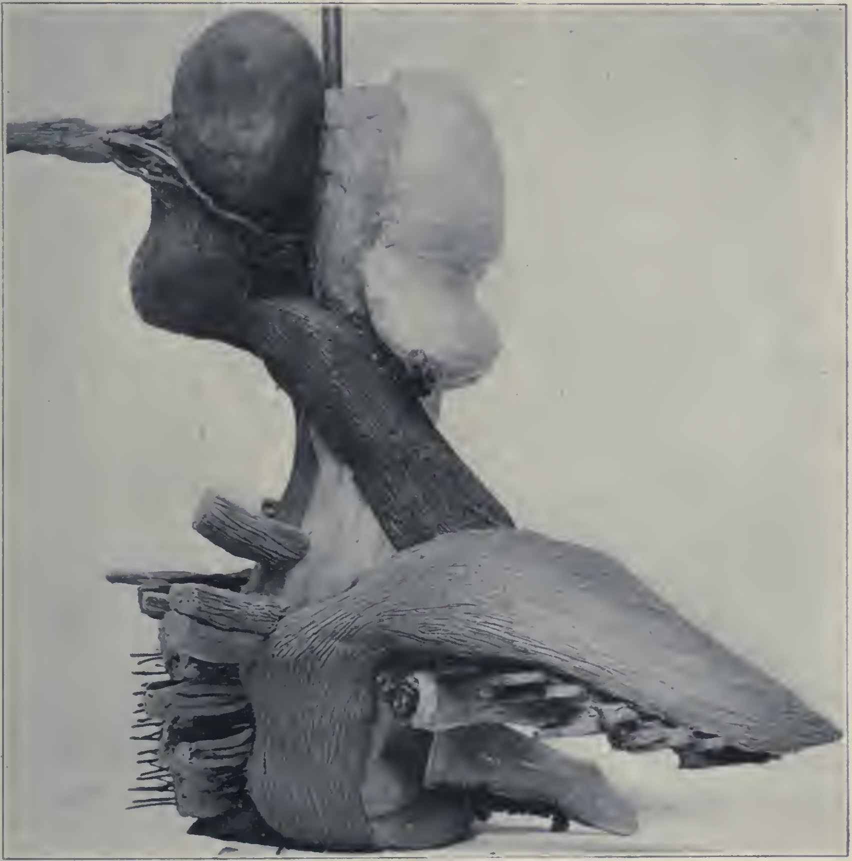

Fig. 14.—*Left Lateral View of Figure 13.* The direct cerebellar tract is seen flowing into the restiform body, which sweeps in broad curves over the superior cerebellar arm and the dentate nucleus. The superior and inferior colliculi have been added, preparatory to the construction of the anterior medullary velum and the cerebellar cortex (Fig. 16). Note the left trochlear nerve appearing between the inferior colliculus and the superior cerebellar arm.

In this figure the tuberculum acusticum has been left off in order not to obscure the part of the restiform body which it embraces; these relations can be seen in Figure 15. The lateral pocket has been cut off. × 2.5.

Having constructed these parts, we next place the optic chiasm and the optic tracts, which should be put on loose enough to let the crus cerebri (to be constructed later) pass to the basal surface. Above the chiasm we build the lamina terminalis, carrying dorsally the anterior commissure which connects the striata and the olfactory bulbs. In relation to this phase of the reconstruction, we consider the paraterminal body, consisting of the anterior perforated substance, with the pedunculus septi and its nucleus basalis, and the commissural mass—corpus callosum, septum pellucidum, fornix or hippocampal commissure and fornix column.

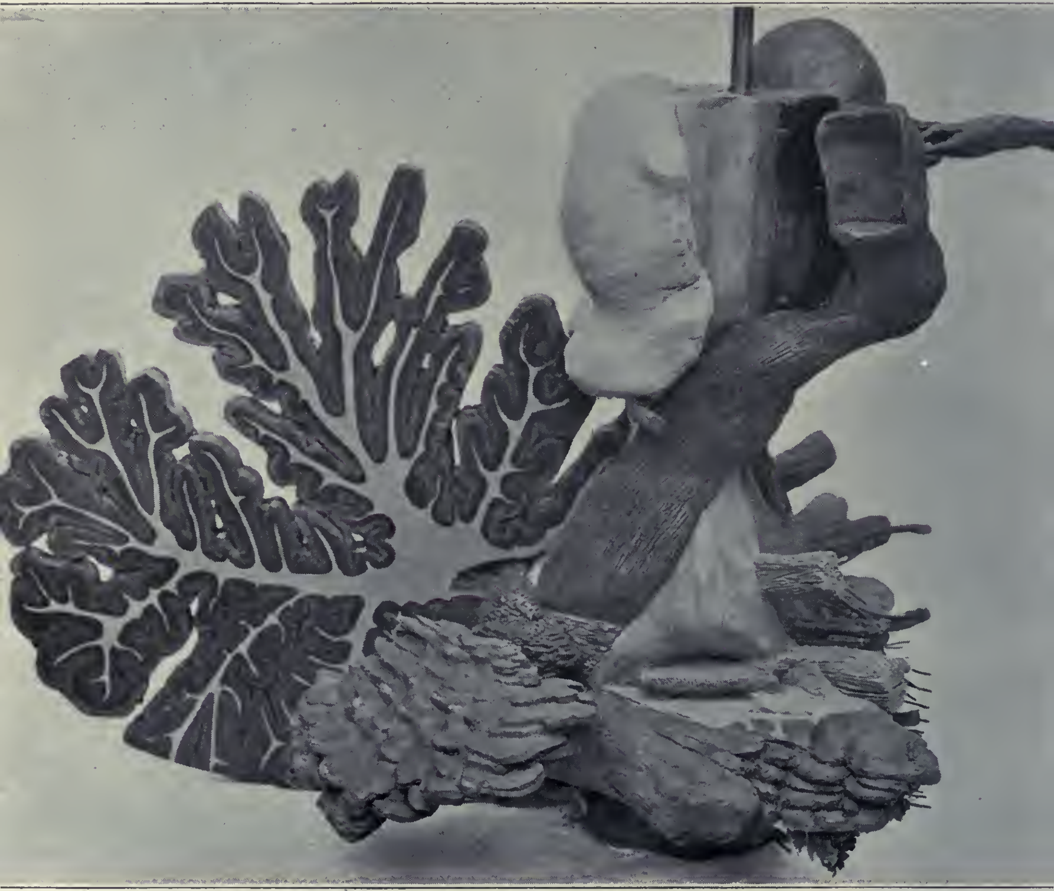

Fig. 15.—*Right Lateral View.* Note the addition of the cerebellar cortex (only a slice through the mesial part of the vermis being indicated) and the flocculus with its peduncle. The restiform body, embraced by the cochlear mass, is cut off in order not to obscure the other structures; reduced from photograph × 3.3.

The next stage of the reconstruction comprises the olfactory lobe and tubercle, the lateral olfactory root and gyrus ending in the cortex of the amygdala and uncus, and the mesial olfactory gyrus, phylogenetically the first and oldest part of the highest integrator—the cerebral cortex.

Over the amygdala there arises the corpus striatum, perforated by the internal capsule, which anteriorly, and behind and below, only partly splits off the caudate from the putamen mass. By means of the striato-Luysian bundle, the large-celled mass, that is, the globus pallidus, is connected with the hypothalamus and substantia nigra.

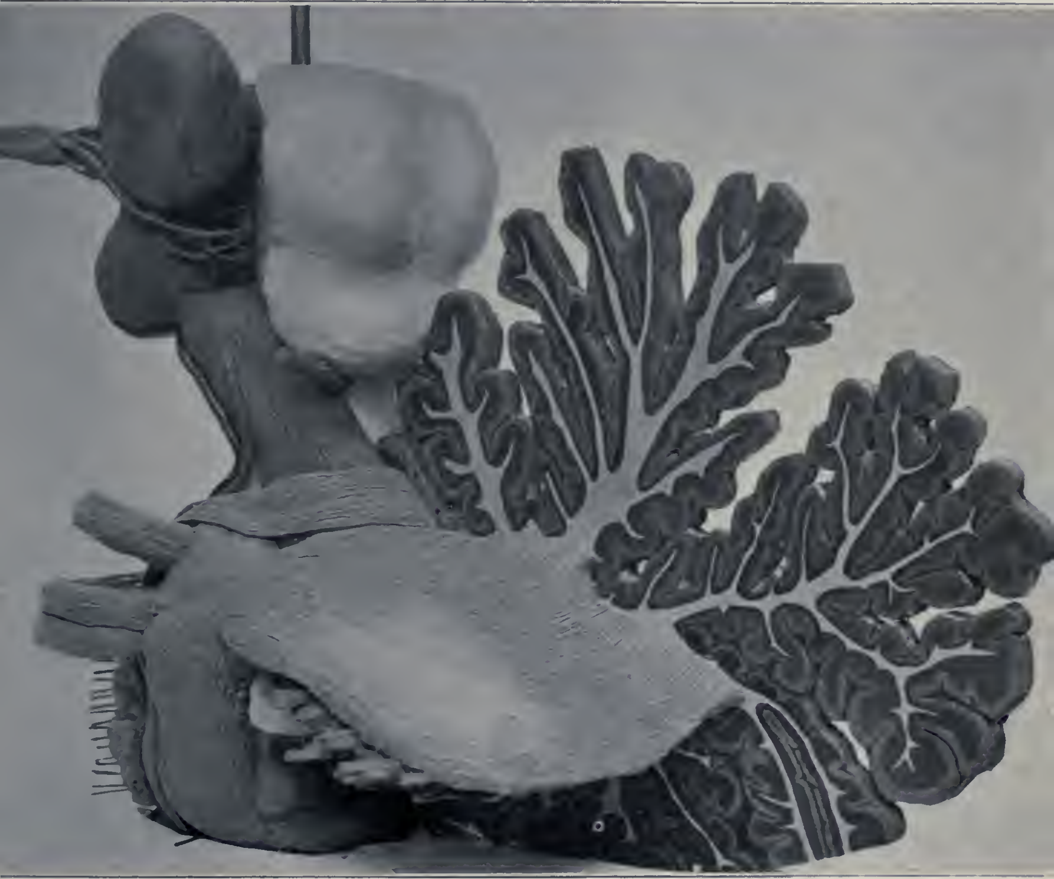

Fig. 16.—*Left Lateral View.* The restiform body is seen entering the cerebellar cortex. The indirect cerebellar tract described by Gowers has been added; after hooking around the trigeminal roots it passes over the superior cerebellar arm to terminate in the cells of the cerebellar cortex; its spinothalamic component, whose course is here only partly indicated, can best be studied in Figure 17. Ventral to the latter is the rubrospinal tract. Reduced from photograph × 3.3.

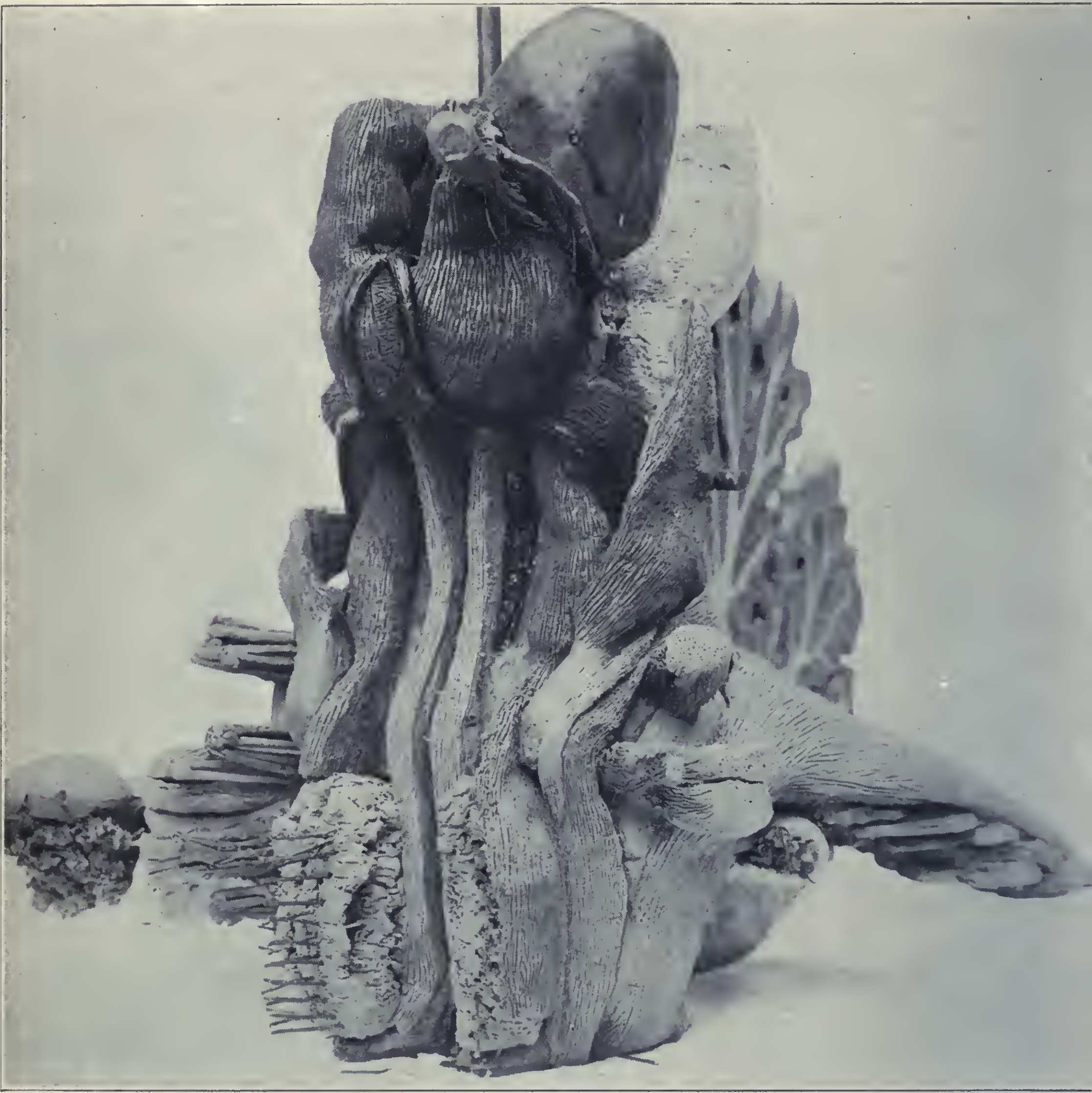

Fig. 17.—*Left Ventrolateral View.* Reconstruction of the superior olives, lateral fillets, thalamo-olivary and colliculospinal systems. The superior olives occupy the lateral portions of the middle and anterior hindbrain segments; the left lateral fillet is seen entering the inferior colliculus of that side, whereas the right, which follows a similar course, is shown only in part; immediately ventral to the posterior longitudinal bundles are the colliculospinal or predorsal fasiculi, the interolivary fibers having been removed in order to give an unobstructed view; between the superior olive and the colliculospinal tract courses the thalamo-olivary bundle, which is seen to spread out over the lateral surface of the inferior olive. Note the rubrospinal tracts and their crossing in the upper part of the superior cerebellar arm decussation. Attention is directed to the course of the spinothalamic tract as it winds beneath the lateral fillet to ascend along its mesial border. To give a better view of the indirect cerebellar tract, the glossopharyngeal, vagus and accessory nerve roots have been removed. × 3.3.

From the olfactory tubercle to the uncus there extends as the dorsomesial border of the hemisphere cortex the mesial olfactory gyrus, consisting of the striae Lancisii and cornu ammonis, the latter also giving origin to the mesial wall or fornix radiation of the hemisphere.

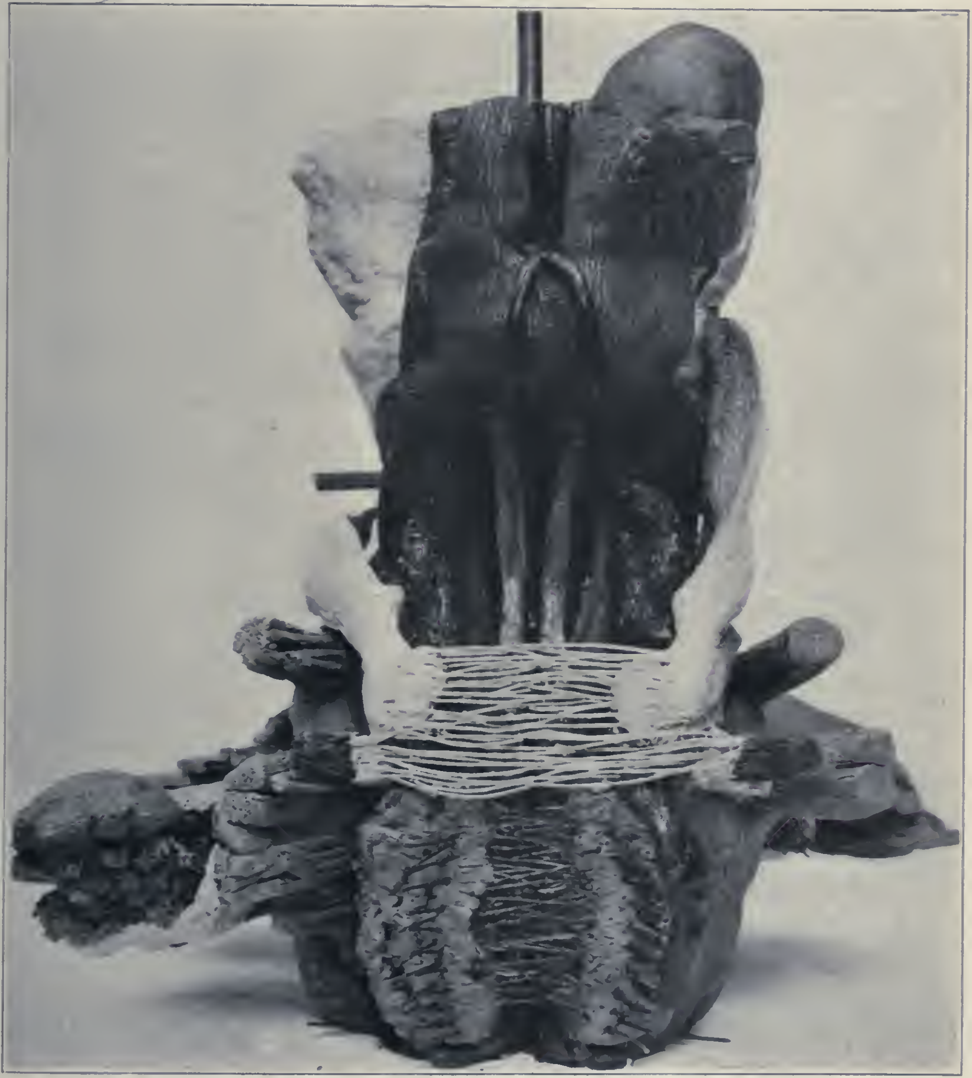

Fig. 18.—*Ventral View* of *Figure* 17, with the addition of the trapezoid body and its nucleus. × 3.2.

Between the mesial olfactory and the lateral olfactory gyri, the convexity of the hemisphere is formed by the neocortex, giving rise to the lateral wall radiation, that is, the internal capsule.

We next add the cerebral afferent tracts consisting of the auditory, visual and general sensory (mesial and superior) fillets and the efferent tracts consisting of the corticopontile and corticosegmental or pyramidal systems.

Thus we find in man essentially three dorsal or dorsolateral blind pockets or terminal bodies of the neural tube, each one a suprasegmental organ: the cerebellum, the striatum and the cerebral cortex. The thalamus is treated as a relay station with some terminal functions, but in the main having definite interdependence with the hemisphere functions. It is the cerebral cortex that brings under one head the psychobiologic integrations.

COMMENT

This bare outline has been set forth with the idea of conveying the perspective we aim to attain in familiarizing the student with the data of neuro-anatomy. Before he is led into a maze of innumerable details, he is first provided with a solid three dimensional foundation and a general frame, in which it becomes comparatively easy for him to insert the discussion of the rubral system or any other special points. It gives him a dynamic concept and a plastic instrument to work with, and every step, building from the inside out, first the segmental and then the suprasegmental structures, is determined in gross specimens and models, serial sections and photographs, and brought to expression in a plasteline reconstruction.

GUIDE TO FIGURES

Figures 6 to 18, inclusive, are photographs of an accurate reconstruction (of the midbrain and hindbrain of an adult) made by Dr. Hausman from a complete series of Weigert-stained cross-sections, each 66 microns thick. The material used is plasteline, which is ideal for this purpose as it provides simplicity without sacrificing accuracy. The original model is enlarged six times, and in colors: blue and brick-red for the receptor and motor segmental elements, respectively, orange for the efferent cerebellar mechanisms and violet for the auditory apparatus.

Figures 6 to 9, inclusive, give the segmental reconstruction; Figures 10 to 16, inclusive, the cerebellar reconstruction with the pons connections left off; Figures 17 and 18, the midbrain.

A model of the forebrain is in process of construction and an article on the forebrain will be published at a later date.

INTRACRANIAL ANEURYSM OF THE VERTEBRAL ARTERY *

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CHICAGO

Although small aneurysmal dilatations are common in any and all of the cerebral vessels, large intracranial aneurysms are rare. Thus, Hoffmann,[1] in reporting on seventy-eight intracranial aneurysms observed during twenty years' examination of medicolegal cases in Vienna, describes chiefly minute dilatations or diffuse enlargement of the cerebral arteries, and not aneurysms of a size that would be likely to produce pressure symptoms. Most of these cases had come to necropsy because of sudden death from rupture of the dilatations, and had not been observed clinically. The aneurysms were distributed as follows in seventy-five cases:

Arteries of the sylvian fissures	20
Carotids	13
Anterior communicating	12
Basilar	10
Vertebral	10
Miscellaneous	10
Total	75

Of these, fifty-three were in women and twenty-two in men, which reverses the proportions usually observed in aneurysms. It is to be noted that of the ten aneurysms of the vertebral artery, seven were on the left side; this predominance of the left side is usually described. Thus, Oppe,[2] who in 1892 collected reports of seven cases of aneursyms of the vertebral artery, found that six were in the left.

Möser,[3] describing three cases of what were virtually simple dilatations of the left vertebral artery, comments on the fact that thrombosis and embolism also usually affect the left vertebral artery. He made a study of the vertebral arteries in several bodies and found that the left artery is usually somewhat larger than the right (average, 2.43 as against 2.18 mm. diameter), but that there is almost always a constriction at the point where the left vertebral joins the basilar, and less often on the right side, the average amount of narrowing being 0.318 and 0.24 mm. for the left and right arteries, respectively.

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* Presented by request before the Chicago Neurological Society, Dec. 15, 1921.

* From the Department of Pathology, University of Chicago, and the Otho S. A. Sprague Memorial Institute.

1. Wien. klin. Wchnschr. **7**:824, 1894.
2. München. med. Abhandl. Ser. 2, 1892; quoted by Steckelmacher.
3. Möser: Deutsch. Arch. klin. Med. **35**:418, 1884.

In 142 cases of cerebral aneurysm reviewed by Krey[4] none was in the vertebral arteries. Beadles[5] compiled 555 cases of aneurysm of the cerebral arteries, all but 114 of which had been previously published. Unfortunately, he gives no analysis of this great material, but he has little to say concerning vertebral artery aneurysms, so presumably they were not numerous. He mentions only three such cases. The chief facts brought out by him are that in 46.3 per cent. of cerebral aneurysms the first symptom was apoplexy, in 67 per cent. death was preceded by apoplexy, and in 20.7 per cent. there were clinical evidences of intracranial tumor, which most often occurred with aneurysms of the basilar artery, which he discusses at some length. In only 16.39 per cent. was there no cerebral or meningeal hemorrhage. He describes one aneurysm of the left internal carotid artery which measured 1¾ by 1⅛ (45 cm. by 29 cm.) inches, and states that this ranks among the largest intracranial aneurysms on record. "Its size has been exceeded by few, probably less than a dozen." These large aneurysms have arisen mostly from either the carotid or the basilar artery; he makes no mention of vertebral aneurysms in this group. Some of these aneurysms were the size of "a small orange," "a duck's egg," "a small hen's egg," "the size of a nut," whatever these comparisons may signify. Some, with measurements given, exceeded 2 inches in diameter. The largest vertebral aneurysm that I have found reported, that of Steckelmacher,[6] is uncertain since the diagnosis rested on clinical evidence only. The aneurysm eroded the left half of the supra-occipital bone, and formed a large visible external swelling. The patient was still alive when the case was reported, so the origin cannot be considered as positively established.

The classical illustration of aneurysm of the vertebral artery published by Cruveilhier[7] in his famous atlas, involved the right vertebral artery, and, to judge from the illustration, measured about 15 mm. in diameter.

There has appeared recently a report of a case of vertebral aneurysm of comparatively large size, described by J. Floyd Morrow.[8] This was observed in a body used for dissection in a medical school, and consequently there was no history.

> The man was apparently 50 years of age, and, as no other evident cause for his death was found, it was assumed that he had died from paralysis of

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[4] Inaug. Dissert. Greiswald quoted by Rhein: J. Nerv. & Ment. Dis. **41**:360, 1914.

[5] Beadles: Brain **30**:285, 1907.

[6] Steckelmacher: Deutsch. Ztschr. Nervenheilk. **54**:347, 1916.

[7] Cruveilhier: Anatomie Pathologique du Corps Humain **2**:28, 1835, pl. 3.

[8] Morrow, J. Floyd: Med. Rec. **100**:894, 1921.

the vital centers. The aneurysm is described as "a spontaneously cured fusiform aneurysm of the right vertebral artery. The aneurysmal dilatation began 1.5 cm. from the bifurcation of the basilar artery, and increased abruptly to its greatest diameter of 2.5 cm. This extreme dilatation was continued for a distance of 3 cm. downward and the artery again very abruptly assumed its normal diameter." There was a channel on the side toward the medulla, of approximately normal size. There was much calcification of the wall. The left vertebral artery was crowded laterally and showed a dilatation for about 2.5 cm. of its course with a diameter of nearly 1 cm. This artery was very sclerotic as also was the circle of Willis. The medulla was pressed into an unrecognizable mass by the aneurysm. The anterior surface of the medulla was concave, much flattened and pushed backward between the cerebellar lobes, but there was no softening. The pons was pressed slightly upward on the left. Much degeneration of sensory and motor tracts was shown by Marchi staining. There is no statement made as to evidence of syphilis elsewhere in the body.

Most of the other cases recorded concern small aneurysms, like the "cherry pit" sized aneurysm of the left vertebral artery reported by Schultze,[9] which was unusual in producing a marked convulsive tic involving the left facial nerve, without degeneration of the nerve. In this case death resulted from pulmonary tuberculosis. We also have the two vertebral aneurysms observed among twenty-two cases of ruptured intracranial aneurysms described by Wichern.[10] Both of these were in males, one in the right vertebral artery, 3 to 4 mm. in diameter, and one in the left, "a pea sized sac."

Weidman [11] states that since Beadle's report in 1907 only seven cases have been indexed up to 1915. The largest of these aneurysms was reported by Boinet,[12] measuring 30 by 15 mm., involving the left vertebral artery, and associated with several gummas of the brain and meninges. An aneurysm like that in Wiedman's case also occurred in a man, aged 40, with syphilis, but it was only "pea sized."

A striking feature about most of the ruptured cases, however, is the lack of any mention of the presence of evidences of syphilis. Usually the absence of such evidences is particularly mentioned.

Turnbull [13] discusses the etiology of forty-eight cerebral aneurysms and finds that none of them seemed to be of syphilitic origin, although he recognizes that this is the dominant cause of aneurysm of the aorta; and occasionally in other arteries. In this series he attributed fifteen aneurysms to infected emboli and thirty-three to medial degeneration following congenital developmental deficiency. Hedinger[14] reports an aneurysm (1 cm. by 4 to 5 mm.) in the left vertebral artery observed shortly after a fall backward downstairs with injury to the neck and shoulders, and believes that the aneurysm was of traumatic origin since there were no evidences of arterial disease elsewhere, and no signs of syphilis. He speaks of having had also three cases of ruptured aneurysm of the "arteria vertebralis et basilaris" in syphilitic patients, without giving details.

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[9] Virchows Arch. f. path. Anat. **65**:385, 1875.

[10] Wichern: Deutsch. Ztschr. f. Nervenh. **44**:220, 1912.

[11] Weidman, Fred D.: Ruptured Aneurysm of the Right Vertebral Artery, J. A. M. A. **65**:1105 (Sept. 25) 1915; Am. J. M. Sc. **151**:427, 1916.

[12] Compt. end. Soc. de Biol. **69**:210, 1910.

[13] Turnbull: Brain **41**:50, 1918.

Several other writers on intracranial aneurysm have attributed importance to traumatism in their etiology. It is indeed easy to imagine that the larger arteries may readily suffer traumatism from violent blows on the skull, since we know from the evidence concerning fractures and cerebral contusions *a contre-coup,* that sudden alterations in intracranial relations take place that must almost certainly put a sudden severe strain on the large vessels at the base on account of their fixation to the skull.

Direct traumatic aneurysms in the cervical portion of the vertebral artery have been described, especially from wounds received in the World War, but these do not concern us here. The literature has been largely collected by Kuttner[15] and Kausch.[16]

The evident rarity of large intracranial aneurysms in the vertebral arteries makes it desirable to put on record a case that I have recently examined, despite the fact that no adequate neurologic examination was made before death. This is especially regrettable since the size and location of the aneurysm were such that symptoms of a cerebellopontile angle tumor should certainly have been present, and we know that some at least were.

REPORT OF A CASE

The subject was a colored man, 54 years old, who entered the Illinois Central Hospital on Dec. 21, 1920, complaining of pain in the left side, loss of weight and weakness. He had difficulty in urination; the urine was scanty, and the patient had had nocturia during the last three months, getting up two or three times during the night and passing only a small amount of urine. He had had some dizziness since September, during which month it was marked. He had also diminished vision.

The patient gave a history of typhoid, pneumonia and measles during childhood, and malaria twenty-two years ago. He used whisky slightly and admitted having had gonorrhea but no chancre. His wife was living and well; she had not had children, but had an abortion soon after marriage. Two of his brothers were dead, and he had four sisters who were living and well. The man had been ill for about four months; he became ill in bed in September and had worked two weeks since that time.

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[14] Hedinger: Cor.-Bl. f. schweiz. Aerzte **47**:1393, 1917.

[15] Kuttner: Beitr. klin. Chir. **108**:1, 1917.

[16] Zentralbl. f. Chir. **45**:885, 1918.

Physical Examination (made in the hospital).—The pupils reacted to light and accommodation and were regular. The patient expectorated large quantities of whitish yellow sputum having a foul odor. The lungs showed dulness over both bases. Mucous râles were present over both sides anteriorly. Several teeth were missing and one was carious. The tongue was furred. The tonsils were hidden. No paralyses of any kind were noted.

The apex beat was under the nipple at the fourth interspace. The left border of the heart was 2 cm. outside the nipple. The right side was under the sternum. The heart sounds were normal.

The abdomen was flat, contained no fluid, showed no tenderness and no organs were palpable. The genitals were normal. There was a slight inguinal adenopathy. The knee reflex was absent, the patient being moribund.

Roentgen-ray examination showed pyorrhea of all the remaining teeth. The heart was greatly enlarged, lying in a transverse position, greatly distended and pulsating heavily. The urine showed a few pus cells and hyalin casts. While in the hospital the patient coughed a great deal, especially when trying to swallow liquids, which he swallowed with much difficulty.

Course of Illness.—On January 1, the patient fell out of bed. On January 2, he was unable to take food and coughed a great deal; his breathing was labored; he still swallowed with difficulty. On January 4 he was semiconscious, the pulse and the general condition were poor.

The temperature fluctuated between 101 and 103 F. until the last day when it rose from 99 to 106. The pulse increased from 100 on the day of admission to 160 on the day of death, January 5.

These findings merely indicated a bilateral pneumonia, probably hypostatic, and in the advanced stage of this terminal infection, with the patient moribund most of the time, no evidence of nerve lesions was detected. Evidently there were no marked facial or ocular paralyses, since doubtless these would have been observed. After the necropsy the widow was interviewed, and we obtained the following additional facts:

History Obtained from Widow.—When the patient was about 18 years old, while walking on a railroad trestle, he was struck by a train. He was knocked to the ground about 12 or 15 feet (365.76 to 457.2 cm.) below, and his forehead hit a rock. He remained unconscious for three or four days. The injury on his forehead was described as being about "the size of a fifty-cent piece." He was treated at home and no surgical procedures were employed. As far as could be ascertained, there was no immediate functional effect, but the patient had said that he had felt foolish for some time afterward. He was married when 23. No history was obtainable of his condition in the interval between injury and marriage. He was apparently well until eight or ten years ago when he began complaining of headaches. At times he would sit and hold his head in his hands because of the pain. He complained particularly of pain at the top of his head where it felt "as if the flesh was nailed to his head." These headaches became worse. He worked as an elevator man for the last five years before his death.

About three years ago, while sitting in a chair, the patient had what his wife called a "spell." He shook all over for about ten or fifteen minutes, after which he had a high fever and sweated profusely, and said his eyes felt as if they were crossed. A physician was called, who advised him to stay in bed. He remained in bed five days and at home twelve days. His body was tender all over; he could not stand to be rubbed with a liniment. A physician prescribed mercury for him. He went back to work but was very weak for one week. A few months later in the same year he had another similar attack. During the attack his mind was clear. He went to work the next morning but was weak. Two months later he had a third attack and went to work the next morning but was weak the day following.

The following autumn he complained of his teeth and was advised to have them extracted. About three months later two teeth were extracted. A few months afterward he came home sick, still complaining of his teeth. He was advised by the company physician to have more teeth extracted, which was done, but no relief was obtained. He felt as if he were cross-eyed. He was fitted with two pairs of eyeglasses but obtained no relief. He was always complaining of roaring in his ears. After having the teeth extracted he went to work. One day in November, 1920, while at work, he had what was called a paralytic stroke. He fell down in the elevator and had to be assisted to his feet. Information was not obtained as to whether he became unconscious or not. He recovered from this attack and came home alone, but later found he could not walk steadily. About three weeks later he complained that his legs felt like lead although he was able to move them slightly. He lost control of urination and stools, became unable to articulate and could not swallow. He grew steadily worse. His eyes were affected so that he could not recognize objects held before them. Apparently no facial paralysis existed. He was then taken to the hospital.

The records of the company physician contain no reference to any symptoms that could be referred to the intracranial tumor, and physicians who saw him daily at his work observed no evidence of any facial paralysis.

Necropsy Examination.—This examination was performed about eighteen hours after death.

External Appearance: The body was that of a well nourished and well developed colored man about 54 years old. There was no icterus. The superficial lymph glands were not noticeably enlarged. There was no edema of the ankles. The edges of the tibiae were smooth and there were no scars on the external genitals. There was about 1 cm. of subcutaneous fat. A small fatty hernia of the round ligament of the liver was found in the midline, about 2 cm. in diameter.

Pleural Cavities: The left pleural cavity was free from fluid and from adhesions except between the pericardium and the base of the left upper lobe. The thymus was replaced by fat.

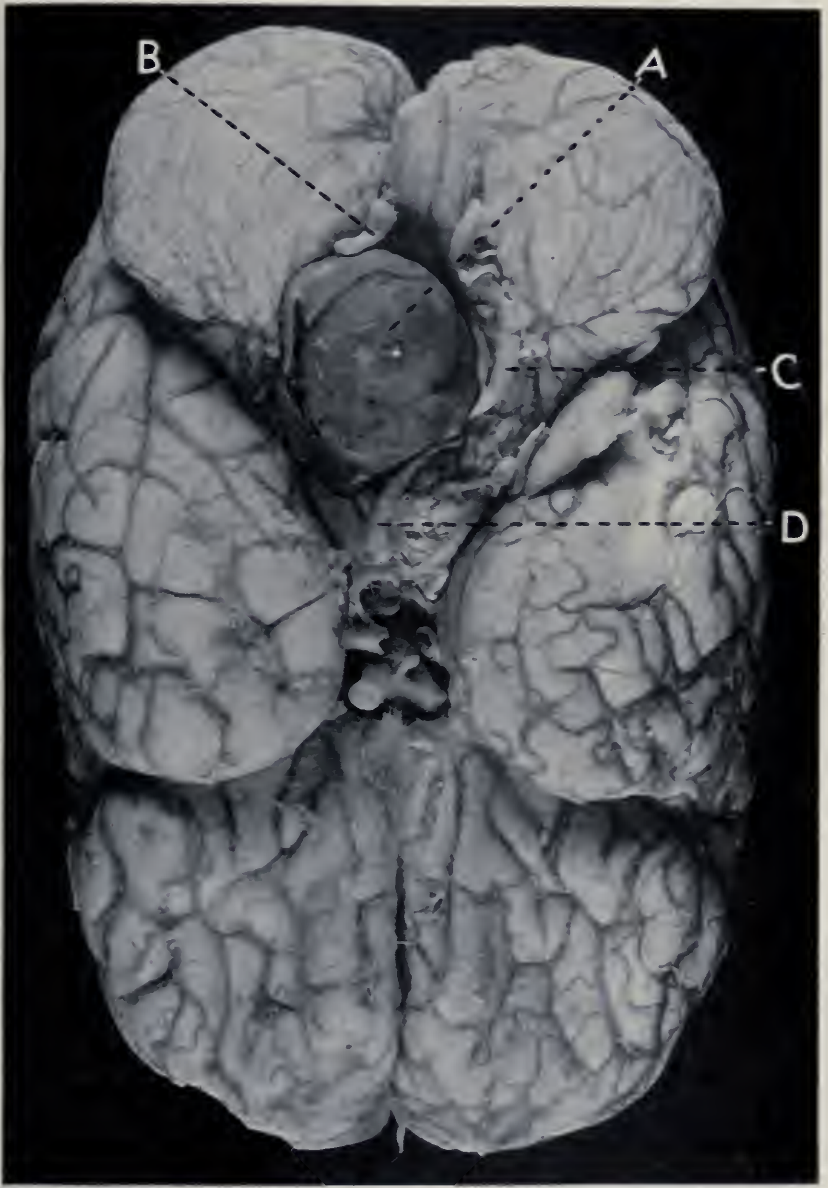
The right pleural cavity contained a few adhesions along the anterior margin of the lower lobe. Elsewhere it was free from adhesions and contained no fluids.

Pericardial Cavity: This was normal.

Mouth and Pharynx: Many teeth were missing, and there was infection of the gums around those remaining. Otherwise there were no changes.

Larynx and Trachea: These showed no changes.

Heart, Aorta and Vessels: The heart was considerably enlarged, chiefly by hypertrophy of the left ventricle. The coronary vessels from the outside showed many calcified spots. The inner surface of the coronary arteries showed numerous yellow sclerotic patches. The valves were normal. There were extensive subendocardial hemorrhages in the left ventricle, chiefly in the upper portion. The myocardium was apparently normal except for a few small areas of fibrosis. The wall of the left ventricle was 15 mm., of the right ventricle



A, aneurysm of the left vertebral artery. Note that it has crowded and compressed the medulla upward and to the right. The defect observed was produced by removing material for sections. *B,* left vertebral artery which abruptly enters the aneurysmal sac; *C,* right vertebral artery; very sclerotic and crowded to the right; *D,* basilar artery.

3 to 4 mm., thick. There were a few small sclerotic patches in the arch and descending portion of the aorta. Both cavities of the heart were enlarged. The estimated weight of the organ was 400 gm.

Lungs: These showed marked bilateral hypostatic congestion with bronchopneumonia. The peribronchial lymph glands were extremely anthracotic but showed no evidences of caseation or calcification.

Liver and Gallbladder: These organs were normal.

Spleen: The spleen was small and distinctly fibrotic but not hard. There were fibrous adhesions between the spleen and the stomach.

Pancreas: The pancreas was small but normal in appearance.

Gastro-Intestinal Tract: The stomach showed numerous submucous hemorrhages, especially in the cardia, but was otherwise normal. The intestines showed no abnormality.

Suprarenals: The suprarenals were normal.

Kidneys: The kidneys were slightly smaller than usual. The cut surface of the left kidney showed the cortical markings well preserved. The capsule stripped readily leaving a smooth surface. The right kidney was also normal.

Urinary Tract: The urinary bladder was normal.

The prostate was somewhat enlarged. Nodules of hyperplasia were present in the median lobe, which protruded slightly under the mucosa of the bladder.

The seminal vesicles were normal.

There were numerous calcified thrombi in the periprostatic veins.

Lymph Glands: In general, these were normal.

Brain and Meninges: There was some rachitic deformity of the skull. The dura was very thin. The veins on the surface were distended. The vertex of the brain was in close contact with the dura. There was a small amount of clear cerebrospinal fluid. The sulci of the brain were much flattened, and the lateral ventricles were greatly dilated, each measuring 25 mm. across in the widest parts. The hypophysis was normal. There was a nearly spherical, chocolate-brown tumor lying exactly at the junction of the pons and the medulla, both of which were compressed (see illustration). The tumor was nowhere adherent but was held in place by the blood vessels which entered it. About 80 per cent. of the tumor lay to the left of the median line. The basilar artery was crowded to the right and the left vertebral artery entered the tumor at a point near the inferior external angle. This artery reappeared again at a point 2 cm. nearer the midline at the same level, at a point 7 mm. from its junction with the basilar artery. The covering of the mass was continuous with that of the artery. The mass measured 34 mm. in its anteroposterior diameter, 30 mm. transversely, and 35 mm. vertically. The superior surface forced itself into the space formed by crowding the medulla from the cerebellum, reaching a point about 15 mm. above the inferior surface of the medulla. It was filled with a mass of dark, granular clot, somewhat laminated, with numerous calcified areas near the arterial side, and no fluid blood. The shape of the aneurysm had been partly molded by the adjacent brain tissue, for there was a somewhat pyramidal projection of the superior surface into the angle between the cerebellum, medulla and pons. The basilar and vertebral arteries were very sclerotic with areas of calcification, and the other cerebral arteries also were sclerotic.

The left vertebral artery had an extremely thick wall in the portion proximal to the aneurysm, with only a minute lumen remaining. Distal to the aneurysm it was occluded by a thrombus up to the point where it entered the basilar artery. The left vertebral artery was only about one half the size of the right, which was of the same diameter as the basilar artery. Apparently the left vertebral artery had been occluded for a long enough time to permit secondary sclerosis of the left and compensatory dilatation of the right vertebral artery. There were a few soft protrusions from the surface of the tumor which was covered by a smooth capsule. The cerebellum was slightly compressed at the anteromesial angle, and the medulla was pushed upward and to the right, being distinctly curved. The sixth to ninth left cranial nerves were flattened between the aneurysm and the cerebellum. The anterior margin of the tumor was just posterior to the fifth nerve origin.

There was a distinct grooving at the base of the skull involving the sphenoid bone and the occipital bone at the site where the tumor lay, just anterior to the foramen magnum. The dura was intact at this place, and the tumor was not adherent to it, nor was the dura abnormally adherent to the skull at this point. No evidence of any old injury to the skull was observed.

Microscopic examination of the wall of the aneurysm showed it to be composed solely of a thin membrane of dense hyalinized fibrous tissue, in which no elastic tissue or other remains of the artery wall could be detected, at least in the portion examined. The sac contained masses of clotted blood, much disintegrated, with no evidence of infection. There were a few small calcified masses attached to the vessel wall but within the clot. There was no evidence of organization of the clot, and no inflammatory reaction in the wall of the aneurysm.

The aorta showed merely a simple senile sclerosis. Neither here nor elsewhere could evidence of syphilis be found. No microscopic changes of importance were found in the other tissues.

Anatomic Diagnosis.—The anatomic diagnosis was: Saccular aneurysm of the left vertebral artery, with compression of the pons, cerebellum and medulla, and roots of the sixth to the ninth cranial nerves; pressure deformity of base of the skull; dilatation of the cerebral ventricles; bilateral hypostatic bronchopneumonia; diffuse senile arteriosclerosis; hypertrophy of the left cardiac ventricle; slight fibrous myocarditis; ventral fatty hernia; slight rachitic deformity of the skull and tibiae; subendocardial hemorrhages.

SUMMARY

A colored man, with no clinical or anatomic evidence of syphilis, but with a history of severe cranial traumatism many years before, died of hypostatic bronchopneumonia, without giving marked evidence of increased intracranial pressure or of cranial nerve paralysis during his last illness. Necropsy examination revealed a large aneurysm of the left vertebral artery, causing much deformity about the cerebellopontile angle, compressing the sixth to ninth cranial nerves, occluding the left vertebral artery, and, by pressure on the aqueduct of Sylvius, causing distinct internal hydrocephalus. That the swelling had been present for a long time was indicated by the presence of a distinct grooving in the floor of the skull beneath it. A necropsy inquiry revealed that the patient had had roaring in the ears, dizziness and "spells" three years before his death. Neuralgic pain and infection about the gums led to the extraction of several teeth four months before death. Two months later there was an attack of syncope. Three weeks before death difficulty of speech, decreased vision and difficulty in swallowing appeared, terminating in hypostatic bronchopneumonia.

As far as can be learned from the literature, this seems to be one of the largest vertebral aneurysms yet observed. It is unfortunate that the patient had not been the subject of a thorough neurologic examination during life, for the differentiation from a cerebellopontile angle tumor would have afforded difficulty. In two or three recorded cases a bruit has been heard over a vertebral aneurysm, but the clue would not have been present here since the artery was completely occluded. This aneurysm corresponds to the statement in the literature that intracranial aneurysms are not usually the result of syphilitic arteriosclerosis, but that they often give a history of antecedent cranial trauma. The presence of a distinct grooving of the skull beneath the aneurysm, without adhesion or erosion, would support the hypothesis that the aneurysm might have formed after the injury to the 18-year-old boy. Probably this yielding of the skull permitted the aneurysm to reach the exceptionally large size it had attained.

A SILVER DIFFUSION METHOD FOR STAINING NERVE FIBERS IN PARAFFIN SECTIONS *

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The method detailed below varies little from that described by Warthin and Starry [1] for the demonstration of spirochetes in paraffin sections. The only modification has been the substitution of a gelatin film for the capillary space between the two coverslips. Warthin and Starry attached paraffin sections to coverslips, washed them in silver nitrate solution, pressed a second coverslip over the section, and allowed silver nitrate solution to diffuse in between the two coverslips.

When their method was used on a suspected gumma of the brain, it was found that numerous fibers were stained, but none of them could be identified as spirochetes. With the idea of determining the possibilities of the stain in regard to nerve fibers, an investigation was undertaken which resulted in obtaining such preparations as are shown in the illustrations.

One difficulty with the Warthin-Starry coverslip method was the uneven character of the silver deposit. This was done away with by embedding the coverslip, face up, in a warm 10 per cent. gelatin solution, allowing it to harden, and then pouring silver nitrate on the surface. The silver nitrate then diffused down to the section. Later the gelatin was melted off and the coverslip immediately immersed in the developing solution exactly as recommended by the authors cited. Even staining, so much desired in all the silver methods was usually obtained.

The method has its limitations. It is not adapted to anatomic work since it does not stain the finest ramifications of the nerve fibers, nor such fibers as occur in the deeper layers of the retina. Due to shrinkage, the finest pericellular networks cannot be brought out in any but perfect preparations. It has advantages over the Bielschowsky frozen section method in that larger sections are used, even the whole cross section of the pons; the tissues are cut thinner, and the relations are maintained. The neurofibrillae are well shown when not altered by disease. Another advantage is that twin preparations can be made with consecutive sections, the one showing the cell processes and neurofibrilae outlined in silver, and the other showing the identical cells stained by Nissl's method to show the tigroid bodies.

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* From the Laboratory of Neuropathology, Philadelphia General Hospital.

[1] Warthin, A. S., and Starry, A. C.: Second Improved Method for the Demonstration of Spirochaeta Pallida in the Tissues, J. A. M. A. **76**:234 (Jan. 22) 1921.

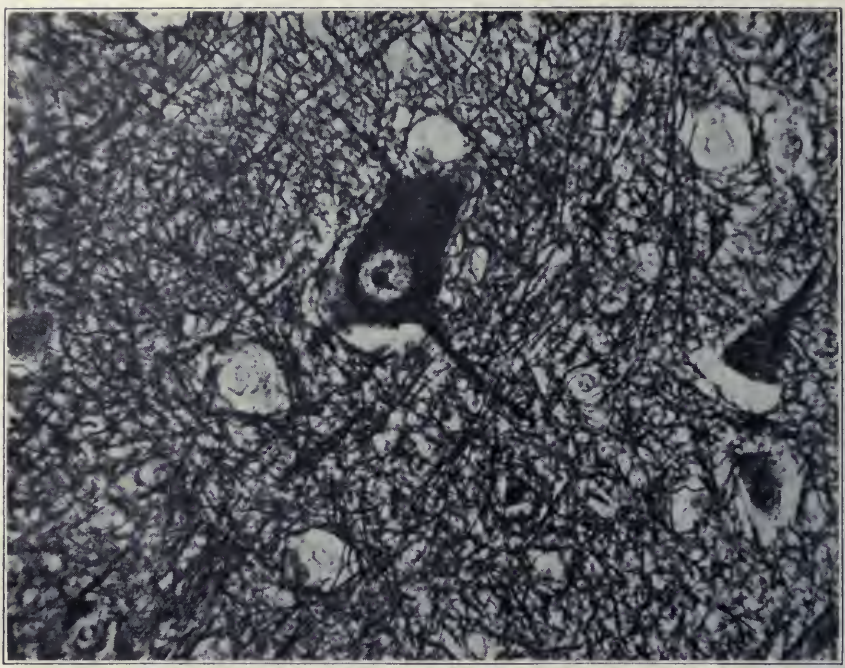

Fig. 1.—Precentral cortex showing Betz cell stained for nerve fibers by silver agar coverslip method.

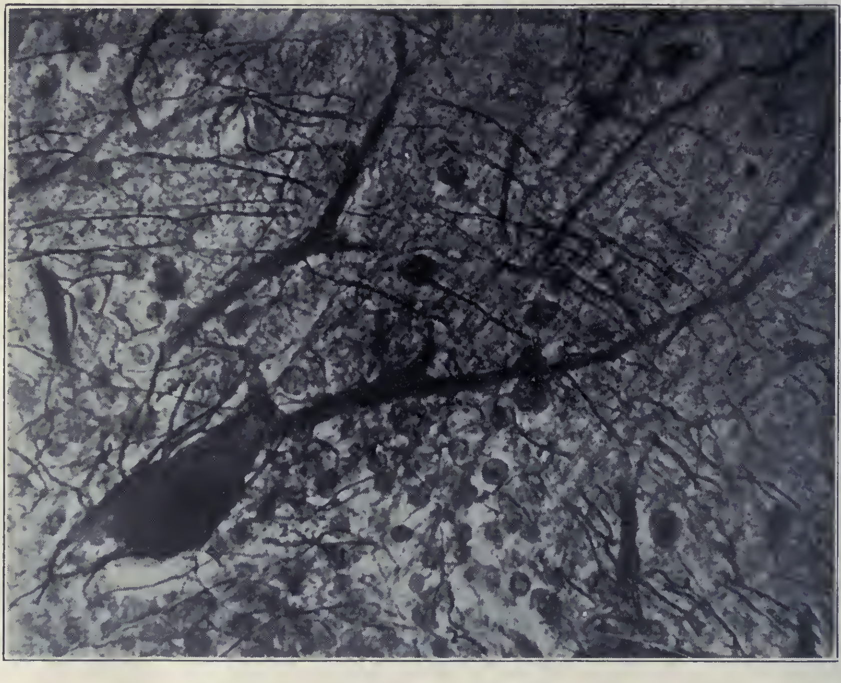

Fig. 2.—Purkinje cell showing basket fibers.

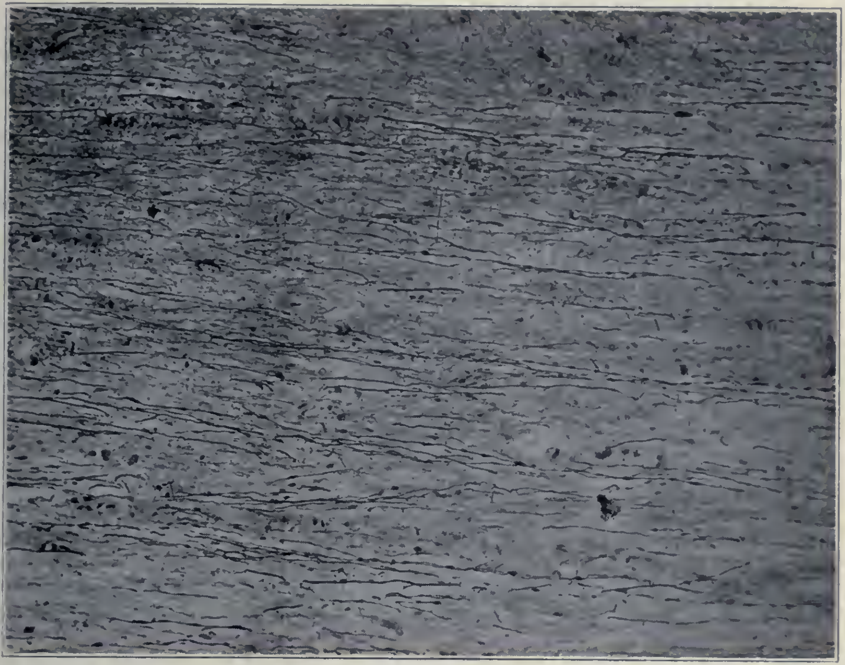

Fig. 3.—Multiple sclerosis; longitudinal section of sclerotic patch stained for axis cylinders.

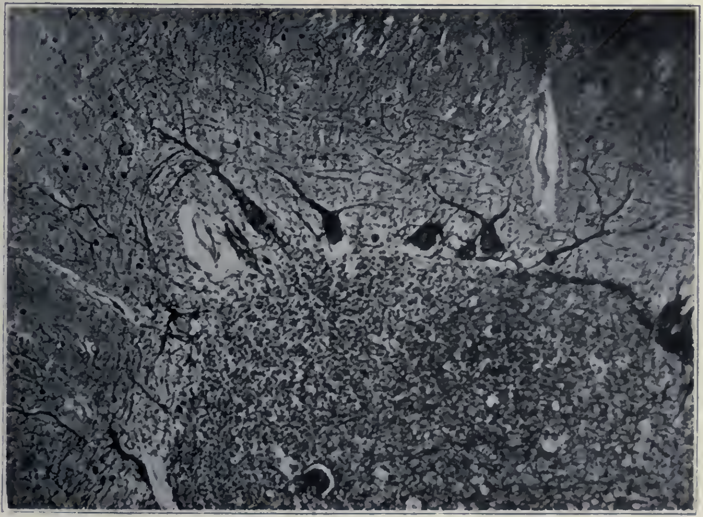

Fig. 4.—Cerebellum; silver diffusion preparation to show nerve cells and processes.

TECHNIC

1. Formaldehyd of alcohol fixation. (Alcohol fixation permits toluidin blue to be used for cell stain with brilliant results.)

2. Paraffin embedding. Cut sections from 5 to 8 microns. These are attached to coverslips which have previously been coated with albumin fixative and dried in the oven over night. They are then blotted and placed in the paraffin oven for from fifteen to thirty minutes.

3. The paraffin is then removed by xylol and the coverslip carried through graded alcohols to water.

4. The coverslip is placed, section side up, in a staining dish the bottom of which is covered by a 5 mm. layer of melted 10 per cent. gelatin, freshly made. The gelatin is allowed to harden and 10 c.c. of 2 per cent. silver nitrate is poured on the surface. This is kept in the dark for twenty-four hours or more. The depth of the gelatin may be increased in order to obtain detail, a longer time being given for diffusion.

5. The gelatin is removed by holding the dish, bottom up, under a hot water tap until the gelatin falls away.

6. The coverslip is plunged without washing into the developer and kept moving until the section is deep brown.

7. It is then washed in water, fixed in 5 per cent. sodium hyposulphite solution, washed again, carried through graded alcohols to xylol and mounted in balsam.

The developer is made as follows:

Glycerin Gelatin (10 per cent.) Agar agar (1.5 per cent.)	warm, of each	5.0 c.c.
Silver nitrate (2 per cent.)		3.0 c.c.
Hydroquinone (5 per cent.)		0.7 c.c.

The glycerin, gelatin and agar agar are added in turn to the silver nitrate, and then the pyrogallol stirred in rapidly. The section is immediately immersed.

All solutions should be fresh and should be made with distilled water. Metal forceps should be coated with paraffin when used in the developer.

THE TREATMENT OF GENERAL PARESIS BY THE INTRACISTERN ROUTE *

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To be conservative in the adoption of new procedures is advisable. This is especially true of the clinical application of puncture of the cisterna magna for diagnostic and therapeutic purposes, owing to the proximity of the medulla oblongata. Wegeforth, Ayer and Essick[1] in their pioneer work have demonstrated the practical value of puncture of the cisterna cerebellomedullaris and the ease with which it is done, after careful anatomic studies on the cadaver. Ayer[2] reports forty-three punctures and says cistern puncture is indicated in the following conditions: (1) spinal subarachnoid block following meningitis; (2) combined with lumbar puncture for irrigation of the subarachnoid space; (3) as a route for injection in epidemic meningitis; (4) in conjunction with lumbar puncture in diagnosis of cord compression.

The object of this paper is to discuss puncture of the cisterna magna in the treatment of general paresis. A total number of 250 punctures has been made in twenty-eight patients.[3] No accidents resulted from the punctures. At the present time I do not feel justified in drawing any conclusions as to results.

Intracistern therapy in general paresis appears to have several advantages. The facility with which cisternal puncture can be performed is a great advantage over the intracerebral method. Treatment is doubtless more intensive than by the intraspinal method since the injection is made nearer the seat of the disease and results in less dilution with probably more widespread dissemination of the serum. Ink injected in the lumbar subdural space, in the same dosage as the serum employed in treatment, has shown little staining at the base of the brain. Intracistern injection of arsphenamized serum, in proper hands, is a safe procedure. There is evidence that this method is rendered more effective following intravenous administration of hypertonic salt solution, for Weed and McKibben[4] in their papers

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* From the New Jersey State Hospital at Trenton.

[1] Wegeforth, Ayer and Essick: The Method of Obtaining Cerebrospinal Fluid by Puncture of the Cisterna Magna, Am. J. M. Sc. **157**:789 (June) 1919.

[2] Ayer, J. B.: Puncture of the Cisterna Magna, Arch. Neurol. & Psychiat. **4**:524 (Nov.) 1920.

[3] Since this paper was presented for publication the total number of punctures has reached 550 in forty-five patients. There were no noteworthy changes in the clinical and serologic results.

[4] Weed and McKibben: Pressure Changes in the Cerebrospinal Fluid Following Intravenous Injection of Solutions of Various Concentrations, Am. J. Physiol. **48**:512 (May) 1919. Experimental Alteration of Brain Bulk, Ibid., p. 531.

have demonstrated that this is followed by a marked fall in cerebrospinal fluid pressure. It seems reasonable to suppose that there will be deeper penetration if serum is administered following this fall in pressure. In this way it may be possible to reach all areas of the brain and syphilitic foci whether the infection is parenchymatous, endarteritic or meningitic. Hypertonic salt solutions have been used in several cases and in each case a marked fall in cerebrospinal pressure has been noted.

At present there seems to be no unanimity as to the best method of injecting arsphenamized serum in the treatment of neurosyphilis. This applies to intraventricular as well as to intraspinal injections and to spinal drainage with intensive intravenous injections. Intracistern injections of serum would seem to be indicated in preference to the intraspinal method since it has been shown by Dandy, in his experimental studies of hydrocephalus, that from three-quarters to four-fifths of the cerebrospinal fluid is absorbed from the subarachnoid spaces of the brain while only one-quarter to one-fifth is taken up from the spinal subarachnoid space. The cisterna magna is the most important distributing reservoir for the other cisternae, and from these the course is to the subarachnoid space and sulci of the brain where the curative serum is probably absorbed. As before stated, I think that this absorption is probably accelerated after the intravenous injection of hypertonic salt solution. In syphilitic infections of the meningitic type, I feel that intracistern therapy is clearly indicated and should give striking results, although I have not had such a case.

Few attempts have been made to treat neurosyphilis by the intracistern method. Berriel,[5] at the University of Paris, has injected arsphenamized serum through the sphenoidal fissure into the large basal subarachnoid cistern. In this country this method has been employed by Kopetzky and Haynes,[6] who have tried it with success in the treatment of meningitis. With the exception of Ayer's work, little has been done with the cisterna magna approach. McKusker,[7] working at the Butler Hospital, published his initial case in October, 1920. Since that time he has been using this method.

METHOD OF TECHNIC

The technic has been fully described by Wegeforth, Ayer and Essick [1] and more recently by Ayer.[2] There is little that can be added to these careful descriptions. The patient assumes the posture (on his side) for lumbar puncture with the neck moderately flexed—facilitated by a pillow under the head. Great care is taken to secure careful alignment of the vertebral column. The skin is sterilized (iodin-alcohol) after careful shaving and cleansing. After the first ten punctures no local anesthesia is employed although cocain is used if the patient desires it. The spine of the axis is carefully located by the index finger. The standard 18 gage nickeloid lumbar puncture needle is used. After perforating the skin just above the axis the needle is pushed upward and forward (anatomically) directly toward the glabella. The external auditory meatus is in the plane of this line and is a handy landmark in determining the inclination of the needle. The dura is pierced at a depth of from 3 cm. to 5 cm. Following Ayer's method, a deadline consisting of a faint circular scratch is made 6 cm. from the tip of the needle.[8] The greater the angle or the nearer one comes to the posterior margin of the foramen magnum, the greater the margin of safety since the cistern is of greatest depth at this point.

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[5] Berriel, M. L.: Bull. et mém. hôp. de Paris **35**:986, 1914.

[6] Kopetzky, S. J., and Haynes, I. S.: Meningitis, Cornell Univ. Monograph, 1912.

[7] McKusker, H.: Some Observations on Cistern Puncture, J. Nerv. & Ment. Dis. **53**:453 (June) 1921.

No clinical punctures were made until careful work on the cadaver had made essential landmarks and relations clear. On the cadaver cistern puncture is much easier to perform than puncture of the lumbar subarachnoid space. Pathologists could advantageously use this method for obtaining fluid for cultivation and examination and for fixation. The interspaces are approximately twice as wide as that between the third and fourth lumbar vertebrae. The sensation on piercing the dura is more definite than that of the lumbar space, and practice enables one to tell when the cistern is entered. Frequently, however, it is necessary to withdraw the stylet before completing the puncture. After one has succeeded in getting rid of the initial apprehension, the technic is easy. It is worthy of note that of our total (250) only six punctures were repeated; two of these were due to movements and poor cooperation by the patient and the others to failure of the operator to locate the spine of the axis and consequently attempting to puncture outside the midline. Attempt at puncture in a negro was given up when no fluid was obtained at a depth of 6 cm. Later it was repeated and owing to the thickness of the skin no fluid was obtained until a depth of 6.5 cm. had been reached. Bloody fluid is less frequently encountered than in lumbar puncture.

We employed the usual Swift-Ellis technic for the preparation of the arsphenamized serum. Our patients were subject to the usual varying ward conditions, and treatment in many cases was at irregular intervals. On Monday of each week the patients were given intravenous injections of 0.3 of a gram of arsphenamin by the usual gravity or syringe method. After the serum was prepared by the standard technic, it was reinforced by the addition of from 0.5 to 1 mg. of arsphenamin. Serums were diluted to the average of 25 c.c. Intracistern injections were given on Tuesday, slowly by the gravity method after drainage of the same amount of fluid. In several cases we drained from 60 to 80 c.c. with no ill effects. In three of our patients we gave hypertonic solutions preceding intracistern injections. In each case we injected intravenously 50 c.c. of the 30 per cent. sodium chlorid solution, just after the cistern had been punctured. We were fortunate in having good cooperation and were able to record pressure changes for periods varying from 15 to 30 minutes, by attaching a manometer to the needle. After the injections of hypertonic solution the fall in pressure was found to correspond to that which has been noted by many observers. Ebaugh and Stevenson[9] have shown the clinical application of this procedure by demonstrating pressure changes in a case of epilepsy. The accompanying curves show the results of these experiments in two cases. It is interesting to note that the change in pressure in each case occurs immediately after intravenous injection is begun.

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[8] A thread tied about the needle serves as well.

RESULTS OF PUNCTURE

We wish to note our observations on: (1) subjective changes during puncture; (2) complaints after puncture; (3) clinical results and serum changes.

These cases represent the average state hospital types of the disease. Unfortunately all of our cases were of long duration. From the psychiatric point of view the diagnosis was definite. They showed, briefly, the following changes: profound sensorium alteration consisting of various degrees of mood alteration and disorientation; marked discrepancies of memory, retention, grasp of general information and calculation; poor judgment, typical speech and writing defects. Neurologically they presented the usual pupillary and reflex changes, facial tremor and in many cases the findings of focal types of this disease. Serologically they showed a typical paretic colloidal gold reaction with increase in globulin and pleocytosis with a positive blood and spinal fluid Wassermann reaction. An attempt has been made to consider the clinical findings and changes separately from the serologic ones.

Changes During Puncture.—The first ten punctures were made after cocainizing the skin. Few difficulties were encountered, although occasionally the needle had to be depressed on touching the edge of the occipital bone. The patients rarely complained of pain and several of them spontaneously asked for the "neck punctures" in preference to the "back punctures." After insertion of the needle the patients did not complain. There were no changes in pulse, respiration or blood pressure, and no vasomotor changes. Cerebrospinal fluid pressures were taken in each case. These demonstrated that the same pressure relations existed in the cisterna as in the lumbar subarachnoid space. The average pressure was about 160 mm. of water; the highest recorded was 325 mm., the lowest 100. Generally from 20 to 30 c.c. of fluid were withdrawn and immediately replaced with serum which was allowed to run in slowly by the gravity method. With one exception, the patients never complained of pain while this was being done.

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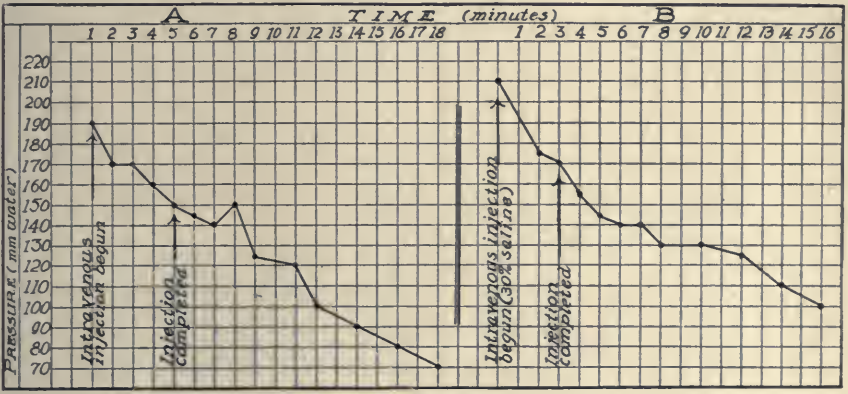
[9] Ebaugh, F. G., and Stevenson, G. S.: Measurements of Intracranial Pressure Changes in an Epileptic and Its Experimental Variations, Johns Hopkins Hosp. Bull. **31**:440 (Dec.) 1920.

Changes After Puncture.—Following the injection the patients remained on the table for several minutes. As is usual in cases of general paresis, the patients rarely complained of headache. They got off the table unassisted and walked to the wards. There were no changes in pulse, respiratory rate or blood pressure, and no vasomotor changes. In no case did nausea and vomiting occur. Two patients complained of headache in the beginning of the treatment, but this was relieved by increasing the periods of rest following puncture. Although this factor is unimportant, it must be studied further. The same reaction frequently occurs with intraspinal injections of arsphenamized serum.



Curves showing the fall in pressure of the cerebrospinal fluid following the intravenous injection of 50 c.c. of 30 per cent. salt solution. *A*, showing the fall in cerebrospinal fluid pressure in patient A. C. from 190 mm. of water to 70 mm. in the course of eighteen minutes. The cisterna magna was punctured after intravenous injection was begun. *B*, showing the fall in cerebrospinal pressure in patient J. N. from 210 mm. of water to 100 mm. in the course of fifteen minutes.

Serologic and Clinical Results.—Our clinical and serologic results thus far have not been striking. Despite the fact that several patients had received previous treatment, the Wassermann reaction of the blood and spinal fluid in most cases remained unchanged. The cell count and globulin gradually reached normal limits after several intracistern injections of arsphenamized serum. At present twelve patients have shown successive negative globulin reactions. None of them shows pleocytosis. The colloidal gold reaction was slow in changing but tends to follow the globulin decrease. The table gives the present status of the patients treated. In order to prevent confusion we have not charted the serologic findings in detail but characterize the changes as good, bad or slight.

The clinical results of intracistern therapy have been equally disappointing. However, one feels justified in further employment of the method. The clinical results do not check with the serologic findings, as is shown briefly in the table. No noteworthy changes were noted in the mental status of any patient with the exception of the patient in Case 27. This case was of short duration, onset followed trauma and the patient has shown proressive improvement.

Clinical and Serologic Results to July 1

No.	Name	Intracistern Injections	Serologic Result	Clinical Result	Remarks
1	L. E.	8	Poor	Poor	Previous intraventricular therapy; blood negative
2	J. J.	11	Poor	Poor	Previous intraventricular therapy
3	W. R.	19	Poor	Poor	Previous intraventricular therapy
4	R. D.	6	Good	Poor	Previous treatment
5	M. Z.	11	Poor	Slight	Globulin now negative; cells 7; colloidal gold test negative
6	A. P.	17	Good	Poor	Negative blood and fluid Wassermann reaction; negative globulin and colloidal gold reactions
7	G. G.	5	Poor	Poor	Gradual deterioration
8	L. P.	14	Good	Bad	Serology negative; no clinical improvement
9	E. T.	9	Poor	Poor	No definite clinical change
10	A. L.	14	Good	Bad	Spinal fluid positive, otherwise serology negative
11	A. C.	9	Slight	Bad	Treatment discontinued; gradual deterioration
12	S. M.	10	Poor	Poor	Patient died of pneumonia
13	J. N.	7	Poor	Poor	No noteworthy clinical changes
14	H. S.	8	Slight	Slight	Globulin negative; cells 5; slight change in Wassermann reactions
15	H. B.	7	Poor	Poor	No changes
16	N. S.	5	Poor	Poor	Patient resistive; rapid deterioration; treatment discontinued
17	J. C.	6	Poor	Poor	No improvement
18	F. T.	6	Slight	Slight	Patient discharged; beginning remission?
19	T. H.	4	Poor	Poor	No improvement
20	R. J.	17	Slight	Poor	No definite clinical changes noted
21	S. S.	19	Good	Poor	Serology reported negative; little change in mental status
22	M. F.	5	Poor	Poor	Gradual deterioration
23	W. O.	6	Poor	Poor	No improvement
24	A. H.	7	Poor	Slight	Endarteritic type; slight improvement
25	V. H.	5	Poor	Slight	Slight clinical improvement; patient bedridden on admission; now up; speech defect less marked
26	W. R.	5	Poor	Poor	No change
27	W. R.	6	Good	Good	Marked clinical improvement
28	A. O.	5	Poor	Poor	No changes

SUMMARY AND CONCLUSIONS

Intracistern injections of arsphenamized serum in the treatment of general paresis theoretically has some advantages over other methods. The facility of the operation makes it more practicable than intracerebral injections. The cisterna magna as a distributing center should promote a more widespread dissemination of serum. Complaints of the patients furnish no contra-indication. No reactions occurred. The operation is a safe clinical procedure.

We fully agree with Ayer's landmarks and technic and his dictum that one should not perform cisternal puncture without preliminary experience on the cadaver.

Cerebrospinal fluid pressure reductions were obtained following the intravenous injection of hypertonic salt solutions similar to those first described by Weed and McKibben.

The clinical and serologic results in the cases treated seem to justify further use of this method.

Philadelphia General Hospital.

THE INCIDENCE AND CHARACTERISTICS OF DYSTHYROIDISM AS AN EX-SERVICE DISABILITY

WITH ESPECIAL REFERENCE TO THE FINDINGS IN DISCHARGED SOLDIERS AND SAILORS, EXAMINED FOR THE BUREAU OF WAR RISK INSURANCE (NOW THE VETERANS' BUREAU), DISTRICT NO. 2 *

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The literature of the late World War early recorded a remarkable frequency of hyperthyroid conditions as compared with their incidence in times of peace. This was noted among combatants and noncombatants in military service, and in the civil population as well. Disabled ex-service men and women who had been invalided, and those less severely disabled in service who had been discharged in good condition but who had had a relapse, have together constituted the examinees of the federal Bureau of War Risk Insurance (the Veterans' Bureau since Aug. 9, 1921) ; here also the incidence of hyperthyroidism has been above normal. H. W. Wright,[1] in a review of postbellum neuroses, separates a group of "secondary neurasthenic states," including those complicated by thyrotoxicoses, or those in which some disorder of the thyroid is a prominent feature. It seemed worth while to review the war literature on dysthyroidisms in the light of postwar conditions—using the term "dysthyroidism" broadly, to include all forms of thyroid anomaly.

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* Permission to publish these data has been granted by Dr. T. M. Baird, medical officer in charge, New York City Station, U. S. Veterans' Bureau, District No. 2. We also wish to express our appreciation of the helpful coöperation of Dr. T. J. Vosburgh, chief neuropsychiatrist, and Katherine D. Smith, special assistant.

[1] Wright, Harold W.: Postbellum Neuroses; a Clinical Review and Discussion of their Mechanism, Arch. Neurol. & Psychiat. **3**:429 (April) 1920.

For 1916, before the United States entered the war, a representative clinic[2] of New York City[3] reported 0.92 per cent. of ductless gland disorders among all neuropsychiatric cases; in 1918, that percentage rose to 3.01, but dropped in 1919 to 1.75. Among the Bureau of War Risk Insurance claimants examined at this office during the first half of 1921, various ductless gland disorders (thyroid, thymic, pituitary, polyglandular, etc.) have been found in 3.93 per cent. of all neuropsychiatric cases, or thyroid disorders in 3.36 per cent. Patients with a neuropsychosis and a thyroid disorder simultaneously, made up 0.59 per cent. of the total number of cases (medical, surgical, etc.).

It is clear that the civilian rate of dysthyroidism incidence rose during the war and has fallen since. The ex-service rate is still high. Statistics are not yet available for comparing its incidence year by year in this district. Surgeon J. G. Townsend[4] of District No. 4 reported earlier this year that "the estimated total neuropsychiatric disabilities present in ex-service men directly traceable to military service is 76,588, this number being further classified as follows . . . endocrinopathies 4,823 . . . " These figures amount to a percentage of 6.29. Our own ratio (3.93 per cent.) is much lower, though still high. A large part of this discrepancy would be taken up by the excessive incidence of goiter in districts[5] in which the endemic type is more prevalent than here. The remaining difference can be construed as evidence—further evidence will be adduced later—pointing toward a beginning post-war decline in total dysthyroidisms. While "the peak for the neuropsychiatric cases is not expected to be reached until 1926,"[4] the relative frequency of hyperthyroidism should be lessening already.

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[2] The New York Neurological Institute Reports enumerate their ductless gland cases together and not by subdivisions, but it may reasonably be assumed that the great majority are cases of dysthyroidism. The 1920 Report cannot be used for comparison since the Institute added a special endocrinologic clinic about the end of 1919, which soon attracted a disproportionate number of cases of ductless gland disorders. The Institute figures are those for males only, while the Bureau figures include a few females; the comparison is approximately correct, which it would not be if the Institute figures for both sexes were taken, since all authorities agree that the incidence of ductless gland disorders is, *caeteris paribus,* far greater in females than in males.

[3] Seventh Annual Report of the Neurological Institute of New York for the Year Ended November 30, 1916. Tenth Annual Report of the Neurological Institute of New York for the Year Ended November 30, 1919.

[4] Townsend, J. G.: Rehabilitation of the Ex-Service Personnel of the World War, Mil. Surgeon **48**:127 (Feb.) 1921.

[5] Addis, T., and Kerr, W. J.: The Relative Frequency in Recruits With and Without Thyroid Enlargement of Certain Signs and Symptoms which Occur in Neurocirculatory Asthenia, Arch. Int. Med. **23**:316 (March) 1919.

French reports particularly have called attention to hyperthyroidism immediately referable to various forms of shock. Léniez[6] describes three cases occurring before 1910, in which cerebral concussion was followed in from one to three months by definite exophthalmic goiter. The same writer saw a number of mild cases of exophthalmic goiter, "formes frustes," following injuries of the head and without previous signs; the struma was seldom large, and true exophthalmos was infrequent. R. Blondel[7] comments on the increase of exophthalmic goiter during the war, both in women and in men. G. Étienne and G. Richard[8] conclude, both from their own observations and from those of others, that cases of exophthalmic goiter occur rather often in active military service. L. Bérard[9] found many cases of exophthalmic goiter, both mild and severe, in military men between the ages of 20 and 45; he rarely saw those in civil life. On the German side, H. Klose[10] treats it as an accepted fact that exophthalmic goiter has been precipitated frequently by the war; he also suggests that the chemical action of gases may have had a share in the etiology. Among American authorities, Crile[11] makes the statement that "iodin alone, adrenalin alone, thyroid extract alone, emotion, exertion, or infection alone, each causes a 'Kinetic Drive' with phenomena similar to those of exophthalmic goiter." According to Harlow Brooks,[12] "emotional shock, fright, or mental trauma is too well established in the etiology of Graves' disease to admit of question."

Hyperthyroidism and war inevitably call to mind the many discussions and investigations of "soldier's heart"—"neurocirculatory asthenia," "effort syndrome," "disordered action of the heart." Was it or was it not hyperthyroidism? Without laboratory tests, we have been disinclined to take a definite stand on this matter. Such patients appearing for examination have tended to separate into three groups instead of remaining together, the cases of some being diagnosed by cardiac examiners and the patients ordered proper treatment without being referred to the neurologists, while others are so referred, but may or may not be given a hyperthyroid diagnosis in addition to that of a cardiac dysfunction, according to the prominence of signs of hyperthyroidism. It would be impossible to estimate the proportions of these three groups. Occasionally we have labeled a case "hyperthyroidism," when the patient's service diagnosis was known to have been "irritable heart" (or an equivalent term); but the thyroid and neurocirculatory diagnoses have not been used interchangeably.

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[6] Léniez: Sur le goitre exophthalmique traumatique, Progrès méd. **31**:215, 1916.

[7] Blondel, R.: L'accroissement d'une cause de stérilité féminine depuis la guerre par le développement de la maladie de Basedow, Bull. gén. d. thérap. **170**:816, 1918-1919.

[8] Étienne, G., and Richard, G.: Maladie de Basedow et émotions de bombardements, Bull. et mém. Soc. méd. d. hôp. de Paris, Ser. 3 **42**:1196 (Dec. 20), 1918.

[9] Bérard, L.: La maladie de Basedow et la guerre, Bull. Acad. de méd., Paris **76**:428 (Nov. 28) 1916.

[10] Klose, Heinrich: Der Kriegs-Basedow Pathogenese, Typen, Verlauf und militärärztliche Bewertung, Med. Klin. **14**:1199 (Dec. 8) 1919.

[11] Crile, G. W.: A Physical Interpretation of Shock, Exhaustion and Restoration, London, 1921, p. 171.

[12] Brooks, Harlow: Hyperthyroidism in the Recruit, Med. Rec. **93**:476 (March 16) 1918.

Divergent views on the proper classification of this "irritable heart of soldiers" may be illustrated by referring to the studies of Thomas Lewis,[13] T. B. Barringer,[14] T. A. Smith and D. Bovaird,[15] T. Addis and W. J. Kerr,[5] L. M. Warfield and F. M. Smith,[16] F. W. Peabody, C. C. Sturgis, J. T. Wearn, H. D. Clough, and Edna H. Tompkins,[17] in favor of discrimination between hyperthyroidism and irritable heart; and to those of Harlow Brooks,[12] J. H. Carroll[18] and G. Railliet,[19] who prefer to consider the two conditions identical. The wartime work of Peabody and his collaborators was particularly exhaustive, including tests of epinephrin sensitiveness and basal metabolism, and finally led them to the conclusion that hyperthyroidism did not play a significant rôle in the production of the syndrome known as the "irritable heart of soldiers."

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13. Lewis, Thomas: Med. Res. Committee, Special Rept. Ser. No. 8, London, 1917.

14. Barringer, T. B., Jr.: "Disordered Action of the Heart" in British Soldiers, J. A. M. A. **69**:1726 (Nov. 17) 1917.

15. Smith, Thayer A., and Bovaird, David: Irritable Heart or Effort Syndrome, Am. J. M. Sc. **156**:872 (Dec.) 1918.

16. Warfield, L. M., and Smith, F. M.: Studies on Irritable Heart. II. Etiology of Irritable Heart, J. Lab. & Clin. Med. **5**:75, 1919-1920.

17. Peabody, F. W.; Clough, H. D.; Sturgis, C. C.; Wearn, J. T., and Tompkins, E. H.: Effects of the Injection of Epinephrin in Soldiers with "Irritable Heart," J. A. M. A. **71**:1912 (Dec. 7) 1918. Wearn, Joseph T., and Sturgis, Cyrus C.: Studies on Epinephrin. I. Effects of the Injection of Epinephrin in Soldiers with "Irritable Heart," Arch. Int. Med. **24**:247 (Sept.) 1919. Tompkins, Edna H.; Sturgis, Cyrus C., and Wearn, Joseph T.: Studies on Epinephrin. II. The Effect of Epinephrin on the Basal Metabolism in Soldiers with "Irritable Heart," in Hyperthyroidism and in Normal Men, Ibid., p. 269. Peabody, Francis W.; Wearn, Joseph T., and Tompkins, Edna H.: Basal Metabolism in Cases of the "Irritable Heart of Soldiers," Med. Clin. North America (Sept.) 1918.

18. Carroll, John H.: Neurocirculatory Asthenia (Soldiers' Heart), Am. J. M. Sc. **158**:35 (July) 1919.

19. Railliet, G.: Basedowisme post-émotionnel et hypertrophie des parotides, Bull. et mém. Soc. méd. d. hôp. de Paris, Ser. 3 **42**:1151 (Dec. 6) 1918.

AUTHORS' MATERIAL

The period covered by our survey dates from Jan. 1, 1921, to July 1, 1921; the cases are those of all former ex-service men and women in this district that had filed claims for compensation from the government on account of disabilities acquired in connection with their military service, and who were consequently examined by the Bureau of War Risk Insurance at the headquarters of District No. 2 in New York City. We include all persons seen at this central office, whether coming from the city or sent in from greater distances for special examinations, and also include city house calls made from the central office. Cases of incidental complaints among war risk beneficiaries in federal training for rehabilitation (under the then "Federal Board for Vocational Education") are not included.

For this period the daily reports of general initial examinations and general reexaminations show a total of 18,675, exclusive of special examinations and consultations. In determining the number of persons examined, which must be less than the total number of examinations because many men received complete reexaminations within the six months, a review of 500 cases showed that 421 of that number were examined once during the set period, seventy-one twice, seven three times, and one four times. This is at the rate of 1,176 examinations per 1,000 persons. Proportionately, the total of 18,675 general examinations represent 15,880 persons examined. Of these, 2,797 claimants received neuropsychiatric examinations in addition to the general examinations (that is, approximately 3,290 neuropsychiatric examinations were made). Among those 2,797, the neuropsychiatric total, ninety-four examinees were found to have some form of thyroid disorder in addition to their nervous or mental complaint. A few goitrous cases with no subjective or objective neurologic symptomatology may have escaped the neuropsychiatric section, but it has been the policy to require a neuropsychiatric examination in all cases of endocrinopathy.

CLASSIFICATION OF CASES OF THYROID DYSFUNCTION

Cases that make up a series showing thyroid dysfunction can be theoretically separated by symptoms into four general groups: (1) toxic thyroid, (2) dysthyroid (in the narrowest sense), (3) hypothyroid, and (4) simple goiter. Group 2 connotes cases of disturbed thyroid activity in which neither hyper-activity nor hypo-activity can be said to dominate the picture. None of these cases was observed. Group 3 is self-explanatory; similarly, no examples were found. (Very few patients had been operated on, and those rather recently.) Group 4 comprises cases of goiter, whether cystic or adenomatous, in which no evidence of dysfunction was determined but in which there was some concomitant neurologic or psychiatric disorder; only one case could be so classified.

Group 1, comprising ninety-three cases, calls for special attention and subdivision. Various fundamenta divisionis are found in the literature. We have taken the well-recognized clinical types, exophthalmic and toxic nonexophthalmic, with a transitional group of "mixed" cases. Our data do not justify an attempt to classify by the presence or absence of hyperplasia.[20] Similarly the conceptions [10] of struma basedowiana as opposed to struma basedowificata, and those of idiopathic and symptomatic exophthalmic goiter, have been kept in view while not being used primarily. "Sympathicotonic" and "vagotonic," [21] however, are feasible as well as valuable conceptions; while their limits are not strictly coterminous with those of toxic exophthalmic and toxic nonexophthalmic goiter, they are sufficiently so to warrant mutual comparisons among findings classified by the two sets of criteria. The nature of examining work in the Bureau of War Risk Insurance has not permitted intensive study of the symptomatology of any group, nor has there been an opportunity to determine reactions to epinephrin injection, thyroid feeding, basal metabolism or other tests. These have been conducted only in the Public Health Service hospitals, or others to which patients could be referred for intensive study and treatment, and are outside the scope of this paper.

Five exophthalmic, sixty-three toxic nonexophthalmic, and twenty-five mixed, made up the total number of toxic cases. The criteria of classification corresponded approximately to those familiar as "sympathicotonic" and "vagotonic." There were no cases of pure sympathicotonia or vagotonia. The cases grouped as exophthalmic were characterized, mainly, by a marked degree of exophthalmos and of tachycardia, and by the absence of hyperhidrosis.

In the mixed group, 68 per cent. of the patients exhibited more or less exophthalmos, and 36 per cent. positive von Graefe and Stellwag signs. In 32 per cent., the pulse rate sitting was 100 or over; 52 per cent. showed well marked hyperhidrosis. In the toxic nonexophthalmic group, 15 per cent. showed a tendency toward exophthalmos, and 20 per cent. had a pulse rate, sitting, of 100 or over. Forty per cent. had typical hyperhidrosis.

Definite visible and palpable thyroid enlargement was present in approximately one half of the hyperthyroid cases, taking the three groups together; it was more frequent in the nonexophthalmic than in the others. The usual tendency toward a more marked affection of the right lobe than of the left was verified. Typical fine hyperthyroid tremor was the rule.

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[20] Plummer, Henry S.: The Function of the Thyroid, Normal and Abnormal, Trans. Ass. Am. Phys. **31**:128, 1916.

[21] Eppinger and Hess: Vagotonia, trans. by Kraus, Walter Max, and Jelliffe, Smith Ely, J. Nerv. & Ment. Dis. Monograph, N. Y., 1915.

Psychotic tendencies, when present, were in the direction of mild depressed states. M. S. Woodbury[22] remarks that thyrotoxic psychosis probably does not deserve a separate classification, but adds that in cases of patients not actually insane a definite mental and nervous picture does appear, differing somewhat in type according to the type of dysthyroidism present. He finds practically all patients with toxic cases "nervous" in some degree, from moderate nervous hypertension to extreme restlessness, excitability and irritability, all these symptoms being less striking in nonexophthalmic than in exophthalmic goiter. Our findings are identical in these respects. His conclusion that a depression of moderate duration is commoner in toxic nonexophthalmic than in toxic exophthalmic cases could not be verified, since that symptom was observed in only five of the ninety-three cases; these five patients, however, all had toxic nonexophthalmic goiter. Next to "nervousness," the commonest single psychoneurotic symptom was insomnia, occurring in one fifth of our series.

ETIOLOGY

An acute infection preceding the onset of hyperthyroidism, or a chronic infection concurrent with it, whether in a causal relationship or not, appeared in the histories of approximately three quarters of the series. With the exceptions of pharyngitis or tonsillitis (in six cases), influenza (in nine), and chronic bronchitis (in fourteen), no one infection was associated with more than one or two cases of hyperthyroidism. C. A. Roeder[23] reported a number of cases of toxic goiter "developing rapidly and immediately following the infection" (epidemic influenza). J. H. Carroll[18] noted that "men ill with trench fever uniformly evidenced marked vagal phenomena during the febrile and convalescent stages." Trench fever did not appear at all in our series. It is a fair assumption that many of the patients with hyperthyroid cases caused by the war, at least of the vagotonic or toxic nonexophthalmic type, have made good recoveries.

Although quite in agreement with those who ascribe etiologic importance to shell-fire and gassing, we have drawn no conclusions from the presence or absence of these causative factors on account of their uncertain history. Gas is too frequently named by the patient now as a cause for all ills, even more so than in the American Expeditionary Forces. Hyperthyroidism arising in gas warfare may be referable to gas intoxication directly, or may be part of a "gas syndrome" or "gas neurosis" (differentiated by Schwab[24]) considered psychoneurotically.

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[22] Woodbury, M. S.: The Psycho-Neurotic Syndrome of Hyperthyroidism, J. Nerv. & Ment. Dis. **47**:401 (June) 1918.

[23] Roeder, C. A.: Toxic Goiter Following Epidemic Influenza, Surg. Gyn. & Obst. **30**:357 (April) 1920.

[24] Schwab, Sidney I.: The War Neuroses as Physiologic Conservations, Arch. of Neurol. & Psychiat. **1**:579 (May) 1919.

High explosive shelling with possibly resultant[24] "concussion syndrome," "concussion neurosis," or other psychoneurosis, which may be accompanied by hyperthyroidism, can rarely be reckoned positively present or positively absent in a given case history.

TREATMENT AND COURSE

Operations on the thyroid were performed in only eight cases, with results showing no significant difference between patients treated surgically and those treated medically. In either instance, any governmental control over treatment is uncertain at best. Many examinations, being initial during the period studied, afforded no bases for comparisons; many others, not initial, showed no net gain or loss; about one quarter of the total were marked definitely "better" (60 per cent.) or "worse" (40 per cent.), and this predominance of improvement applied to each of the three subgroups, toxic nonexophthalmic, exophthalmic and mixed. Most (78 per cent.) of the series were rated by the examiners as "feasible for vocational training," but the success of those persons who have undertaken it cannot be determined for some time.

Many factors other than strictly medical or surgical considerations will necessarily influence the further course of the disease in any one of these cases. Almost all of the patients are *a priori* psychoneurotic and prone to chronic invalidism; their youth is favorable, but their compensability may be a hindrance; even intensive handling of psychoneurotic patients, as summarized by Richards,[25] scarcely promises brilliant results.

Von Noorden[26] maintained that neither the purely vagotonic nor the purely sympathicotonic type of exophthalmic goiter was accompanied by psychopathologic symptoms; these were confined to mixed types of the disease. The more prevalent conception today is that all cases of exophthalmic goiter are more or less mixed and may be more or less psychoneurotic. In our series, the "mixed" cases are those in which neither exophthalmic (sympathicotonic) nor nonexophthalmic (vagotonic) tendencies are definitely predominant.

SUMMARY

To summarize, our material consisted of ninety-four consecutive outpatient cases, clinically examined, of war veterans suffering from thyroid dysfunction accompanied by some neuropsychiatric disorder. We conclude: (1) that the incidence of dysthyroidism, increased by the war, is now on the decline but has not yet reached its prewar level; (2) that the bulk of this increase is made up of toxic nonexophthalmic, vagotonic cases, and cases transitional between this and the sympathicotonic type; (3) that many causes for the increase have been variously operative, none predominating; and (4) that there is a distinct tendency toward improvement in all types of toxic cases caused by the war.

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[25] Richards, Esther L.: A Study of the Invalid Reaction, Arch. Neurol. & Psychiat. **2**:393 (Oct.) 1919.

[26] Von Noorden, Karl: Zur Kenntnis der Vagotonischen und Sympathikotonischen Fälle von Morbus Basedowii, Kiel, 1911.

A CASE OF HEREDITARY ATAXIA (FRIEDREICH) WITH ANATOMIC FINDINGS

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CASE REPORT

H. G., a man, born May 22, 1887, apparently was well during early childhood. His father died at the age of 50 from acute nephritis, his mother was living and healthy. The family consisted of one son and three daughters. One of the daughters died in early infancy, the other two were in good health; they were married and had families. Apparently his grandparents lived to an old age. While the family of one of his sisters had not exhibited any hereditary tendencies, two of the children of the other displayed significant symptoms. There was no history of syphilis or tuberculosis in the family.

The patient walked and talked at 18 months. At the age of 7 he had measles. Beginning when 6 years, he went to school for seven years and did fairly well with his studies. He then became a machinist's apprentice. When 14 years old, one afternoon he became dizzy and faint and had to be assisted to his home. He was quite nervous and later showed some ataxia, so that he did not return to work for nearly four months. During the next three years he worked, but there was considerable unsteadiness of gait. This increased so that at 18 years of age he could no longer obtain employment. He also suffered from pains and jerking movements in the extremities. The arms were weak and his hands were shaky. He was able, however, to get about for several years with the aid of a cane or crutches, but subsequently walking became practically impossible.

The patient was rather thin, 5 feet 4 inches (163 cm.) in height and weighed 119 pounds (54 kg.). His head was well shaped and inclined somewhat forward. There were no eruptions or discolorations and no glandular enlargements. The thoracic and abdominal organs and the genito-urinary system were normal. The Wassermann reaction with the blood and spinal fluid was negative. The spine showed marked dorsal curvature, convexity to the right, extending from the fifth dorsal vertebra to the first lumbar.

The pupils were normal, but turning the eyes to the side, up or down, caused irregular twitchings. When protruded, the tongue showed fine oscillatory movements. The voice was low and monotonous, and speech slurred, especially for some words. Knee and elbow reflexes were absent, the visceral reflexes intact, the plantar reflexes were exaggerated and the abdominal reflexes quite active.

The upper extremities presented no deformity; the bones were well shaped, but the muscles on the dorsal aspect of the forearm were smaller than normal. The calf muscles were poorly developed, and the anterolateral group was defective. The heel was drawn up, and the great toe of the left foot was in hyperextension. The other toes were hyperextended at the metatarsophalangeal joint and flexed at the phalangeal joints.

When sitting, there was some swaying of the head and body. Jerking movements of the head and twitching of the face muscles sometimes occurred.

The upper extremities were freely movable. Ataxia was evident. There was difficulty in picking up objects; the movement was awkward and of a wavering, jerking character. The finger to finger and finger to nose tests also revealed ataxia.

Muscular power of the lower limbs was decreased. Neither leg when extended could be raised more than 6 inches (2.34 cm.). In walking with assistance, his steps were short, the feet thrust too far forward and thrown several inches beyond the place they finally touched. The feet reached the floor with a stamp, the toes first, and then the heels. Voluntary movement at the ankle was confined to slight extension. Movement of the toes was better. Passive movement at the ankle was much more extensive.

The disease progressed slowly. Disturbance of sensibility appeared. All light contacts with a wisp of cotton were appreciated over the trunk. On the palmar surfaces of the hands and the distal parts of the fingers, some hypesthesia was present, but over the rest of the upper extremities sensation was normal. Tactile loss was marked on the feet and lower parts of the legs; it was less pronounced toward the knees and absent on the thighs. Sensation for pressure was everywhere normal and there was no analgesia nor thermoanesthesia. Muscular sense was quite defective, and he could recognize only marked differences in weight. He was unable to appreciate form correctly. Vibratory sense was impaired on the hands and wrists, and lost on the feet and lower part of the legs. There was definite loss of the sense of position in the fingers and hands. Passive movements could not be recognized unless extensive. In the lower extremities this was even more pronounced, especially in the feet.

During the latter part of his illness the patient showed considerable irritability and some impairment of judgment and reasoning. He died of lobar pneumonia, fifteen years after the onset of the nervous disease.

Postmortem Examination.—Necropsy examination was performed five hours after death. The body was well preserved, medium sized, and somewhat emaciated.

The calvarium was symmetrical, the wall thick, diploe compact. The dura was not adherent, thickened or discolored. The pia showed slight opacity over the convexity, and the cerebrospinal fluid was somewhat increased.

The brain weighed 1,150 gm. The cerebral hemispheres presented no perceptible atrophy or widening of the fissures, and the convolutional pattern appeared good. The basal vessels were normal. The lateral ventricles were not dilated, and no ependymitis was in evidence. The membranes of the spinal cord were slightly thickened and the cord diminished in size. At different levels the posterior columns were seen to be affected.

The pericardium was normal and contained clear fluid. The heart weighed 220 gm. The right auricle, tricuspid orifice and valves appeared normal. The right ventricular wall was slightly thinned. The cavity was normal. The pulmonary valves and artery were normal. The left auricle was somewhat enlarged. The mitral leaflets were slightly thickened. The left ventricular wall was somewhat thickened; the aortic valve appeared normal. The right lung weighed 710 gm., the left 690 gm. Edema and areas of consolidation were present in both lungs.

The liver weighed 1,400 gm. The surface was smooth, the capsule was somewhat thickened and some passive congestion was present. The gallbladder was normal. The spleen was enlarged, the capsule thickened; the pulp was soft and red in color. The pancreas, stomach and intestines appeared normal.

The right kidney weighed 120 gm.; the left, 130 gm. The capsule stripped readily, the surface was smooth, the cortex and medulla were normal. The bladder showed nothing remarkable.

Microscopic Study.—Numerous pieces from the brain, spinal cord and peripheral nerves were examined by various staining methods: the Nissl, toluidin blue, thionin, Marchi, Weigert, Mallory, Bielschowsky, Mann-Alzheimer, hematoxylin-eosin, sudan III, cresyl-violet, polychrome methylene blue and others.

Sections from the midbrain through the crura cerebri, corpora quadrigemina, geniculate bodies and rubrum, stained by the Weigert-Pal and Marchi methods, revealed no pathologic changes.

Sections from the pons showed no alterations other than slight involvement of a few medullated longitudinal fibers.

In the medulla oblongata, degeneration was present in some fibers of the pyramids. The fibers of the olivary eminence were normal. There was no abnormal change in the fillet or dorsal longitudinal bundle. Atrophy of a considerable number of the fibers of the corpora restiforme was found. The inferior olivary nucleus and the motor nuclei were normal.

In the vicinity of the cuneate and accessory cuneate nuclei, products of degeneration were discernible. An area of degeneration was found in the funiculus cuneatus, involving the cuneate nucleus. Fibers in the nucleus gracilis were markedly atrophied. Near the upper part of the pyramidal decussation, many fibers of the funiculus gracilis and cuneatus were extensively involved. A few degenerated fibers were seen scattered through the lateral and anterior white matter. At a somewhat lower level, pronounced atrophy of the fibers of the funiculus gracilis was found and also a considerable number of degenerated fibers in the funiculus cuneatus. Other parts of the white matter also contained a few degenerated fibers.

Cellular changes in the pons and medulla were not pronounced, but the glia in the region of the pyramidal tracts appeared to be slightly increased. A few nerve cells exhibiting chromatolysis and nuclear alterations were encountered in the nucleus ruber. In the restis disintegrated cells were discernible, and a moderate degree of gliosis.

In sections from the first and second cervical segments of the cord, a narrow strip of apparently healthy fibers was seen between the posterior gray commissure and horns and the area of degeneration in the posterior columns. The column of Goll appeared to be more extensively affected than the column of Burdach. A deficiency of fibers occurred in the region of the crossed pyramidal and spinocerebellar tracts. Degeneration in the direct pyramidal tract was less pronounced. Products of degeneration and granular cells usually occupied the diseased areas; other zones were free.

In the fifth and sixth cervical segments the narrow band of unaltered fibers mentioned in the foregoing was present anterior to the diseased zone and in contiguity to the area of entry of the posterior roots. Degeneration in the columns of Goll and Burdach was well marked, but somewhat less extensive in the latter. The crossed pyramidal tracts were considerably affected with slight involvement of the direct. A moderate degree of fiber degeneration occurred in the posterior part of Gowers' tract. Atrophy of the fibers in the dorsal spinocerebellar tract was well defined.

At the fourth dorsal segment the fibers of the posterior columns were severely degenerated, but a zone of apparently healthy fibers divided the area of degeneration from the entering fibers of the posterior roots and dorsal horns.

The fiber atrophy in the lateral pyramidal tracts was similar to that described in the foregoing. Changes in the dorsal spinocerebellar tract were more pronounced than in the ventral. Medullary rests and lipoid granules dispersed through the degenerated area of the posterior columns were seen in sections stained according to Marchi's method.

In the mid-dorsal region the posterior columns were intensely diseased, especially in the interior of the degenerated area, but they were less diseased in the surrounding zone. A zone of unaffected fibers was interposed between the degenerated area and the dorsal horns. Atrophy in the right pyramidal tract appeared more extensive than in the fourth dorsal segment. The dorsal spinocerebellar and lateral pyramidal tracts showed many disintegrated fibers. At the level of the tenth dorsal roots, marked degeneration obtained in the dorsal columns. The direct spinocerebellar tract was somewhat altered, and the lateral pyramidal tracts considerably affected. In the lumbar region the posterior columns were extensively involved, with considerable change in the lateral pyramidal tracts and some disintegrated fibers in the dorsal spinocerebellar tracts.

With neuroglia stains, a thick netlike structure of varying density was found replacing the atrophied nerve fibers. Within the distended meshes of the network swollen medullary sheaths and axis cylinders were discernible. The proliferated glial fibers usually were homogeneous. Glia cells with pale enlarged nuclei and granular nucleoli and large stellate cells with swollen irregular nuclei were more or less numerous.

In the anterior and posterior horns a few cells showed chromatolysis. A few cells were shrunken, elongated and intensely stained; some were swollen, irregular and showed disintegration of the tigroid substance. Increased pigment and eccentricity of nuclei were seen and occasionally regressive changes. There was slight glial increase. Cells of Clarke's column were badly disintegrated at all levels, with marked proliferation of neuroglia and obliterated capillaries. The anterior roots were normal. The posterior roots exhibited atrophic and disintegrative changes, more pronounced in the lower segments.

In the frontal region of the cerebrum changes were found in the pyramidal layer. Nuclei of cells were enlarged and contained numerous faintly stained granules. In the vicinity of the nuclei the cytoplasm presented a netlike structure, but in the periphery and apical processes was filled with numerous lightly stained particles. Some pyramidal cells were swollen, pale and rounded, the bodies and processes being entirely filled with pale, ill-defined granules, among which irregular, darkly stained masses were frequently distributed. The nuclei were distended and the nuclear membrane delicate, being at times hardly distinguishable from the cytoplasm. The caryoplasm contained fine granules similar to those in the cytoplasm. The axis cylinder processes were unaffected and the neurofibrils well preserved. No neuroglial proliferation was present but progressive gliogenic changes were seen in the vicinity of many ganglion cells. Lipoid granules were not infrequently encountered within the adventitial spaces and cells of the cortical vessels.

In the precentral gyrus the cytologic alterations were slight. Some of the large motor cells were somewhat affected in their staining and morphologic characteristics. Considerable increase in pigment and tigrolysis occurred. The neurofibrils showed no marked alterations. Changes were discernible in many of the associative and commissural neurons. Some cells were swollen and the chromatic substance was lightly stained. In others chromatolytic changes were in evidence and fine dust-like particles were scattered irregularly through the cell. The chromophilic bodies were sometimes aggregated in masses or appeared elongated. Almost complete disappearance of the Nissl substance occurred in some cells, which were reduced to shadows. Shrinkage of the achromatic substance was observed in cells showing degenerative changes, and the tigroid bodies within the cell body and the dendritic processes were more deeply stained. Such cells occasionally appeared elongated as a result of the excessive shrinkage. The nuclei were frequently deformed and dislocated. Increase of glia was proportionate to the changes in the ganglion cells. Satellitosis was present in the vicinity of nerve cells, and glia cells were occasionally seen within the cytoplasm of the altered ganglion cells.

Changes in the postcentral and paracentral gyri were similar to those in the precentral convolution. The basal ganglions revealed no significant alterations of cells or fiber content.

In the corpus dentatum of the cerebellum some of the large triangular and stellate cells were shrunken and atrophic. A few Purkinje cells showed chromatolysis, and neurofibrillar disintegration was perceptible. In the granular layer some cells appeared shrunken, deeply stained and their processes unusually tortuous. Eccentricity of nuclei with pigmentary increase was frequent. Fiber decrease in some areas was seen by using the Bielschowsky and Weigert-Pal methods. In areas of cellular alteration, changes in the neuroglia were evident: increase of glia cells and hyperplasia of neuroglia fibers. The adventitial spaces of capillaries in these zones contained particles of detritus, but no endarteritic changes were perceived.

The peripheral nerves investigated were the ulnar, radial, musculospiral, anterior and posterior tibial, anterior interosseous and sciatic. Atrophic fibers were found in some sections. Most of the fields contained a normal fiber content. In the larger nerves it appeared that a greater degree of atrophy obtained in the peripheral portions.

SENSORY CHANGES IN FRIEDREICH'S ATAXIA

Cases of Friedreich's ataxia have been reported with loss to different forms of sensibility. A number of authors have recorded sensibility as intact, although degeneration of the posterior columns was found in all cases anatomically studied. The preservation of sensation with pronounced degeneration of the posterior columns, seemingly a paradox, has been variously explained.

Friedreich[1] averred that the dorsal columns could not be the principal sensory tracts. Müller[2] thought that sensory impulses were conducted by naked axis cylinders within the degenerated tracts. Déjerine[3] believed that sensation was not affected by degeneration in the columns of Goll, and that alterations in the posterior columns may exist without sensory disturbances.

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[1] Friedreich: Ueber Ataxia mit besonderer Berücksichtigung der hereditären Formen, Virchows Arch. f. path. Anat. **26-27**:391, 1863; Ibid. **68**:145, 1876; Ibid. **70**:140, 1877.

[2] Müller: Zur Pathologie der Friedreichschen Krankheit, Deutsch. Ztschr. f. Nervenheilk. **32**:137, 1907.

[3] Déjerine: Sur une forme particulière de maladie de Friedreich avec atrophie musculaire et troubles de la sensibilité, Méd mod. **1**:477, 1890. Les lesions des racines, des ganglions rachidiens et des nerfs dans un cas de maladie de Friedreich, Rev. neurol. **15**:41, 1907.

Mott[4] claims that the neurons consisting of small cells and fine fibers, which subserve cutaneous sensory and viscero-vascular functions, are not affected in Friedreich's disease as in tabes, and in consequence there are no visceral disturbances or loss of cutaneous sensibility.

While extensive involvement of the nervous system together with disease of other organs of the body is frequently found in Friedreich's ataxia, the changes in the posterior columns are the most definite and invariable feature. The condition is considered essentially as a systemic degeneration of the dorsal columns. In the upper part of the cord the degeneration is not so pronounced, but in the lumbar and sacral regions the degeneration involves almost completely the dorsal column. In the cervical and dorsal regions, the fasciculus marginalis of Lissauer and the dorsal cornu commissural tract, which occupies a triangular interval at the apex of the transsected dorsal column, are practically free from the degenerative process. With these exceptions the dorsal column is intensely degenerated.

It is obvious that the lesion is principally of the long and medium fibers of the posterior column. Degeneration in the pyramidal and spinocerebellar tracts varies in different cases, but seldom equals that of the dorsal column. Involvement of the spinocerebellar tracts is greater in the upper dorsal and cervical regions, whereas the pyramidal tracts are less degenerated in the higher segments. Pyramidal tract degeneration may extend into the midbrain. Occasionally the direct pyramidal tract is slightly affected.

Degeneration of the ganglion cells of Clarke's column occurs; otherwise cellular changes are slight. The muscle fibers and peripheral nerves are sometimes affected. In view of the slight or moderate alteration in the spinal ganglion cells and posterior roots, the degeneration in the dorsal column could hardly be considered as consequent on primary degeneration of the posterior roots and ganglion cells.

The pathologic anatomy of hereditary ataxia, therefore, exhibits extensive system lesions, involving the long spinal tracts to some degree but chiefly those of the posterior column. Obviously sensory impulses transmitted by the affected tracts should be disturbed.

There is evidence that the column of the cord, which is profoundly degenerated in Friedreich's disease, conveys impulses for the recognization of form,[5] size and weight,[6] passive movement and position, compass points applied to the skin[7] and vibration.[8]

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[4] Mott: Arch. Neurol. from the Path. Lab. of the London County Asylums **3**:180, 1907.

It is generally conceded that impulses of deep sensibility utilize two routes to the brain. One is by the long fibers of the dorsal roots and posterior tracts to the optic thalamus and cerebral cortex, ascending uncrossed; the other by the median fibers of the posterior roots, column of Clarke and the dorsal spinocerebellar tract, in the dorsal periphery of the lateral column of the same side to the medulla, thence by the restiform body to the cerebellum, terminating in the vermis. The cerebellar fibers subserve subconscious tactile and coordinatory perceptions, while the cerebral make possible conscious perception of position and motion.

Painful and thermal sensations are conducted by short fibers of the dorsal root system to cells in the posterior horns, thence by fibers of the spinothalamic tract, decussating by way of the anterior commissure and terminating in the optic thalamus.

In my case there was definite loss of the sense of position and of passive movement (conveyed chiefly by the posterior column), with disturbance of vibratory sense and considerable loss in the recognization of weight, form and size. Tactile sensibility was slightly affected over the distal parts of the extremities, but thermal and pain senses were intact.

A number of cases are recorded which exhibit similar sensory disturbances. The loss in sensibility may be difficult to demonstrate in the initial stage. In some cases motor disability appears to be less pronounced, compared with the degree of sensory loss, than we might expect, and *vice versa.* There are advanced cases presenting only moderate ataxia, while others are markedly ataxic, even in the early stages.

A study of the pathology apparently warrants the conclusion that when the forms of sensibility transmitted by the dorsal column are impaired with only moderate ataxia, the degeneration affects principally the posterior tracts; but when sensory loss is slight in proportion to ataxia, the spinocerebellar tracts are affected more intensely than the dorsal column tracts. Many variations therefore occur, depending on the regional preponderance of degeneration. Sensory alteration is invariably first found in the lower extremities, is distal in distribution, usually symmetrical, in the later stages of the disease quite marked, contributing largely to the disability of the patient. The sensory disturbances in my case correspond to the neuropathologic findings, and both conform to the general conception of sensory conduction in the cord. I believe that the characteristic sensory loss in Friedreich's ataxia is an essential rather than an exceptional feature in the symptomatology of the disease.

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[5] Head and Holmes: Sensory Disturbances from Cerebral Lesions, Brain **34**:102, 1911-1912.

[6] Head and Thompson: The Grouping of Afferent Impulses Within the Spinal Cord, Brain **29**:537, 1906.

[7] Head, Rivers and Sherren: The Afferent Nervous System from a New Aspect, Brain **28**:99, 1905.

[8] Bing: Vibrationsgefühl, Neurol. Centralbl. **29**:173, 1900.

TWO RECENT IMPROVEMENTS IN THE STAINING OF SPIROCHETES IN NERVOUS TISSUE

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Since 1916 several important contributions to the study of neurosyphilis have appeared in the German literature. These have been based in part on studies of spirochetes made possible by Jahnel's [1] modification of the method of silver impregnation. Little, if any, reference has been made to these contributions in our American literature. This is probably due to the failure of the periodicals to reach the United States, and to failure or delay in indexing. It is hoped that by here presenting Jahnel's method it will be more accessible and better appreciated. Comment, such as is justified by a short acquaintance with, and use of, the method, will be made.

Similarly the recently published cover-glass method of Warthin and Starry [2] will be referred to.

JAHNEL'S METHOD

The failure of foreign workers to obtain satisfactorily constant results with existing silver impregnation methods in nervous tissue led Jahnel to evolve his method. Our experience with the method in the laboratory of the Psychiatric Institute has been highly satisfactory. The technic, while requiring a long time, offers few pitfalls if the directions are followed. The results are not only very useful, but actually beautiful. With a subdued yellow to yellowish-brown background the spirochetes stand out in marked contrast. The staining of nerve fibers is so suppressed as to eliminate any confusion with spirochetes. Granulation, fraying and precipitate are negligible. While in our experience no old chemicals have been used, Jahnel warns against these. He offers an alternate developer,[3] but owing to the success obtained by using the simpler one, we have not tried the other. No modification of the method has been found necessary. Fixation should be complete; our most beautiful preparations were made with tissue that had been in formaldehyd ten years. In step 1, it is desirable to wash under sterile conditions.

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[1] Jahnel, F.: München. med. Wchnschr. **67**:932 (Aug. 6) 1920.

[2] Warthin, A. S., and Starry, A. C.: Second Improved Method for the Demonstration of Spirochaeta Pallida in the Tissues, J. A. M. A. **76**:234 (Jan. 22) 1921.

[3] Jahnel, F.: München. med. Wchnschr. **67**:1263 (Oct. 29) 1920.

JAHNEL'S METHOD FOR STAINING SPIROCHETES IN THE BRAIN

1. Wash out in water, in from one to three days, thin pieces from 2 to 4 mm. fixed in formaldehyd or alcohol.

2. Place in pure pyridin one to three days.

3. Wash in many changes of water until the pyridin odor almost disappears during a period of from two to three days; this is important. Then allow the pieces to remain a "few days" (einige tage) in a 5 to 10 per cent. formaldehyd solution, U. S. P.

4. Place in water again. (The time in water this time is not stated; probably the washing should be thorough.)

5. Treat with uranium nitrate (Merck), 1 per cent. solution in distilled water, one-half to one hour in the incubator at 37 C. The use of glass wool (lead free) under the tissue helps the penetration but is not absolutely necessary. The purpose of the uranium nitrate is to prevent the coincident staining of other elements of the nervous tissue.

6. Wash out in distilled water for one day.

7. Allow to remain in 96 per cent. alcohol three to eight days.

8. Wash out in distilled water until the block sinks.

9. Place the tissue in a dark (amber) flask and treat it with a freshly prepared silver nitrate solution, 1.5 per cent., five to eight days in the oven at 37 C.

10. Decant the silver nitrate solution; wash the tissue slightly in water; then transfer it to a solution made up as follows:

	c.c.
4 per cent. aqueous solution of pyrogallol................	95
Formaldehyd solution, U. S. P............................	5

Allow the tissue to remain in the solution one to two days.

A later note states that, especially with thicker pieces and fresher material, short washings in water after the silver nitrate treatment and the use of the pyrogallol-acetone-pyridin developer is to be recommended. This developer is made as follows:

	c.c.
4 per cent. pyrogallol....................................	90
Acetone	10

From this decant 15 c.c. and replace by pyridin.

11. Wash out in distilled water; embed in paraffin.

COVER-GLASS METHOD

The cover-glass method of Warthin and Starry, as originally published was not specifically adapted to nervous tissue. Treating the sections with uranium nitrate was given as one alternate in combating the failure of the tissue to stain properly. However, with nervous tissue, this treatment with uranium nitrate seems uniformly necessary. The cover-slip method offers two advantages: It is rapid, and it permits adjacent sections to be examined by other stains. On the other hand, it has the disadvantages of making the tissue somewhat granular, of staining the nerve fibers, although not seriously, and probably breaking up some of the spirochetes so that if few are in the section, the chance of finding them is reduced. Thus negative findings are inconclusive. After the paraffin mounts have been made (this may be done when cutting sections for the other stains), the method requires about one and one-half hours. From thirty minutes to one hour of this time is spent in impregnation, so that the work required actually takes less time. The main pitfall lies in developing. In preparing the developer it is necessary to work rapidly, to stir in the hydroquinone as quickly as possible, and to immerse the cover-slips edge up, since it is but a minute or two until the silver is reduced and the developer changed to an opaque mass. From this mass the cover-slips must be removed in order to determine whether the stain is sufficiently reduced. A yellowish-brown color is most desirable. In view of the fragility of the spirochete, it is further desirable to avoid too rapid hydration or dehydration. On this account we have suggested the graded alcohols in place of absolute alcohol.

COVER-GLASS METHOD

1. Fix completely in 10 per cent. formaldehyd solution, U. S. P., pieces from 5 to 7 mm. thick.

2. Embed in paraffin without washing in water.

3. Cut from 5 to 12 micron sections and mount on specially prepared cover-slips with minimum albumin fixative (three-fourths inch No. 1 coverslips, cleaned thoroughly and dried in the incubator for twelve hours).

4. Remove the paraffin. (Warm over a flame, wash with xylol, descending alcohols and water.)

5. Immerse the section in 1 per cent. uranium nitrate (distilled water) five to eight minutes.

6. Wash in distilled water one minute.

7. Rinse the section and a clean cover-glass in fresh silver nitrate solution, 2 per cent. Apply the rinsed cover-glass to the section so that they will adhere by capillary attraction, and put edge up and against the side in a dark bottle containing half an inch (1.27 cm.) of fresh 2 per cent. silver nitrate solution; cork tightly. Incubate from thirty to sixty minutes in the dark.

8. Separate the cover-slips and put the section into the following reducer. Remove when yellowish to reddish brown.

Mix 2 per cent. silver nitrate 3 c.c., warm 10 per cent. aqueous gelatin 5 c.c., warm glycerin 5 c.c.

With stirring add warm 1.5 per cent. agar suspension, 5 c.c. (The agar suspension is made by mixing 1.5 gm. agar with 100 c.c. cold distilled water, heating slowly, and stirring constantly until it boils. Continue to boil until suspension is complete. Keep on top the paraffin oven.)

With stirring add a 5 per cent. aqueous hydroquinone solution 1 to 2 c.c. just before immersing sections.

9. Rinse the section in a 5 per cent. solution of sodium thiosulphate.

10. Rinse the section in distilled water.

11. Treat with ascending alcohols, xylol; mount it in balsam.

A STUDY OF SINISTRALITY AND MUSCLE COORDINATION IN MUSICIANS, IRON WORKERS AND OTHERS

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INTRODUCTION

In a previous communication,[1] based on a survey of forty-two sinistrals,[2] the idea was advanced that the disorders of speech so often noted in left-handed people are due to congenital inferiority of the central nervous system. If this notion is valid, it would be logical to look for evidence of faulty team-work in various functionally related muscles, for there seems to be no especial reason why, in sinistrals, incoordination should be limited to the muscles of the speech group. Accordingly, a tentative study of sixteen sinistral private patients was made, with the following results: Six admitted an unaccountable and capricious tendency to "bump into things." One is unable to "reverse" in waltzing. Of five who had studied instrumental music, two had made fair progress up to a certain point but considered that they had accomplished little for the outlay of time and money. Both are hampered by a defective sense of tempo and find "sight-reading" an embarrassment. Two others abandoned the study of music because they were "unable to make any headway." The remaining one is a talented player but states that she still finds it difficult to "keep in time." Of these five musicians, two are left-handed and left-eyed, one is left-handed and right-eyed and two are right-handed and left-eyed. Five patients are free from motor symptoms.

These patients seem to show: (1) that sinistrals are especially prone to various forms of muscle incoordination, and (2) that in some of these persons both the sense of equilibrium and the sense of rhythm are defective. Hoping further to elucidate the subject, a study of sinistrality in skilled manual workers was carried out.

MATERIAL

Three series of 100 men each, classified as (1) professional musicians, (2) machinists, and (3) male inmates of a public relief home, were examined.

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[1] Quinan, C.: Sinistrality in Relation to High Blood-Pressure and Defects of Speech, Arch. Int. Med. **27**:256, 1921.

[2] Throughout this paper the word sinistrality is used to designate partial as opposed to established left-sidedness. The most common symptoms of this condition are dominance of the left eye in binocular vision and a limited use of the left hand as the leading hand.

Professional Musicians.—First, players in five orchestras, all members of the musicians union, were examined. The men were tested without selection except that players on stringed instruments were especially sought as representative of the highest product of coordinated muscle activity. They constitute 64 per cent. of all musicians examined. Pianists were put in second place and a few players on wood-wind and brass instruments make up the total. The piano group includes a few unattached professional virtuosi.

It was thought that successful instrumentalists would prove to be almost exclusively dextral, because it seemed likely that left-handed and sinistral persons would instinctively seek a livelihood in some less exacting vocation. Unexpectedly it was found that one in every three musicians could be classified as left-handed or sinistral. Therefore it became necessary to select a control group, and machinists were chosen because in addition to at least average intelligence they offer the desirable combination of trained eyes and powerful muscles.

TABLE 1.—Analysis of One Hundred Professional Musicians with Reference to Sinistrality

	Number Examined	Right-Handed		Left-Handed		Total Sinistrality Percentage
		Dominant Eye		Dominant Eye		
		Right	Left	Right	Left	
Violin and viola	40	27	11	1	1	32.5
Cello and string-bass	24	17	5	0	2	29.1
Piano and organ	18	13	3	1	1	27.7
Flute and oboe	10	8	2	0	0	20.0
Trombone	8	3	3	0	2	62.5
Totals	100	68	24	2	6	32.0

Machinists.—Workers in three large machine shops were chosen. The men were examined without selection. A few apprentices and a small number of iron-workers who had not had the training of a machinist are included in the series.

Relief-Home Inmates.—Finally, a number of old men in a public relief-home were examined. Naturally a good many of these old men were physically infirm and probably of rather low average intelligence, but any man was considered acceptable if he had free use of his extremities together with relatively normal binocular vision.

METHOD OF TESTING

Information was sought from each person as to (1) handedness and (2) eyedness.[3] In musicians, speech defects also were noted and performance tests were made to determine the relative skill of the right and left hands. Here it will suffice to outline the performance test, as the method of determining handedness and eyedness has been described in detail elsewhere.[1]

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[3] Reference here is made to the fact that in normal binocular vision nearly every person has a dominant or "fixing-eye."

Performance Test.—For this purpose I used the ordinary "primary-pegging-board." This consists of a thin piece of board, 10 inches (25.4 cm.) square, one side of which presents 100 shallow holes arranged in ten parallel rows. Wooden pegs are provided with the board. In carrying out the test, in a time allowance of one minute, as many pegs as possible are set up by the right hand always moving to the right. The left hand is tested in like manner but moves toward the left. A peg duly placed, that falls, counts. Although the score of each hand improves with practice, the ratio usually remains fairly constant so that a single trial of skill imposes a uniform handicap.

TABLE 2.—PERFORMANCE TESTS OF THE RIGHT AND LEFT HANDS IN THIRTY-TWO LEFT-HANDED AND SINISTRAL MUSICIANS

No.	Dominant		Pegging Board Scores		History of Stammering	Faulty Rhythm	Notes
	Hand	Eye	Right	Left			
1	L	L	37	46	Yes	Yes	Strongly left-handed
2	L	L	44	49	Yes	....	Strongly left-handed
3	L	L	50	55	Yes	Yes	Strongly left-handed
4	L	L	32	36	....	....	Strongly left-handed
5	L	L	40	34	....	....	Trombonist; writes with left hand
6	L	L	40	48	Yes	....	Strongly left-handed
7	L	R	38	56	Yes	....	Strongly left-handed
8	L	R	31	45	....	....	Strongly left-handed
Aver.	..	..	39	46			
9	R	L	46	34			
10	R	L	49	39	Yes	....	Deals cards with left hand
11	R	L	63	44			
12	R	L	36	31	....	Yes	Deals cards with left hand
13	R	L	46	46	Yes	....	Deals cards with left hand
14	R	L	51	49	Yes	....	Gun at left shoulder, aims with left eye
15	R	L	49	32			
16	R	L	37	37	....	....	His only child is left-handed
17	R	L	48	42	....	....	Deals cards with left hand
18	R	L	30	31	Yes	....	Deals cards with left hand
19	R	L	48	40	....	Yes	
20	R	L	51	43	....	....	Gun at right shoulder, aims with left eye
21	R	L	25	29	....	....	Years ago slight right hemiplegia
22	R	L	45	42			
23	R	L	46	36			
24	R	L	43	38	....	....	Holds spoon, wields axe left-handed
25	R	L	49	36			
26	R	L	38	36	Yes	....	Gun at right shoulder aims with left eye
27	R	L	43	45	....	....	Deals cards with left hand
28	R	L	54	41			
29	R	L	40	30	....	....	Gun at right shoulder, aims with left eye
30	R	L	38	34			
31	R	L	44	38	....	....	Gun at right shoulder, aims with left eye
32	R	L	46	42	....	....	Deals cards with left hand
Aver.	..	..	44.3	38.1			

TABLE 3.—Relation Between Manual and Ocular Dominance in Iron-Workers, Relief-Home Inmates and Professional Musicians

	Nominally Right-Handed		Nominally Left-Handed		Total Sinistrality A+b+c
	Dominant Eye		Dominant Eye		
	Right	Left (a)	Right (b)	Left (c)	
100 machinists and iron-workers	92	4	0	4	8
100 relief-home inmates (male)	78	17	1	4	22
100 professional musicians	68	24	2	6	32

DISCUSSION OF RESULTS

Briefly stated, the results show: 1. It is possible by a performance test to differentiate established left-handedness from the lesser grades of sinistrality. 2. Sinistrality is extremely prevalent in musicians as compared with other skilled manual workers. 3. Sinistral musicians are prone to faulty rhythm and other psychologic disturbances.

DIFFERENTIAL VALUE OF THE PERFORMANCE TEST

(*a*) *Individual Peculiarities.*—Musicians who try this test, even though they make nearly equal scores, exhibit widely different grades of native dexterity; one will make an average score with much fumbling and waste of energy, another will score a like number with the utmost economy of effort. Awkwardness is more characteristic of sinistrals than of dextrals. Indeed two sinistral musicians (Nos. 12 and 18, Table 2) recall Sir Thomas Browne's[4] description of people who are "ambilevous or left-handed on both sides; such as with agility and vigour have not the use of either: who are not gymnastically composed: nor actively use those parts. Now in these there is no right hand." Right-handed people invariably score more with the right than with the left hand. Just the opposite is true of those who are predominantly left-handed. But it is surprising that many musicians who use the left hand rather freely—say in dealing cards, or in other usually right-handed activities—run up average dextral scores. As far as my experience enables me to judge, such men as a rule are left-eyed. Orchestra leaders and musicians of acknowledged virtuosity almost always make scores that are close to, or often a little below, the average. An extremely high score seems to indicate nervousness rather than technical skill. Age, on the other hand, affects the score unfavorably. The idea that the magnitude of a player's score may bear some relation to the technical difficulties of his instrument is not borne out by the tests. On this point the performance scores leave no doubt.

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[4] Browne, Sir Thomas: The Works of Sir Thomas Browne, edited by Charles Sayle, Edinburgh, John Grant **2**:122, 1912.

(*b*) *Differential Scores.*—Forty violin and viola players made an average score of 47.8 for the right hand and 41.1 for the left hand. The corresponding figures for twenty-four cello and string-bass players are 47 and 37.4 and for eighteen piano and organ players 47.6 and 40.4. Obviously these group differences are negligible. Of somewhat greater interest is a comparison of the dextral and sinistral scores.

In the violin group, thirty-eight of the players are right-handed men. Divided with reference to the "master-eye," twenty-seven of the men are right-eyed and eleven are left-eyed. A glance at the performance scores of these two groups shows a slight advantage on the side of the dextrals, as the figures for the right-eyed group are 49 for the right hand and 41.7 for the left hand, while for the left-eyed group the figures are 46.7 and 38, respectively. The difference certainly is not striking, but it is suggestive when considered in connection with the fact (Table 2) that twenty-four sinistral players, all instruments included, have an average score of 44.3 for the right hand and 38.1 for the left hand.

The eight left-handed musicians made an average score of 46 for the left hand and 39 for the right hand. This, it will be noted, is almost exactly the reverse of the right-handed score.

Practically speaking, then, the results show that it is possible to diagnose established left-handedness by means of a simple test. But it is also possible to go farther than this and to utilize this test in the differentiation of left-handedness and sinistrality. This of course is a matter of classification. In the work here reported, it was found convenient to divide the material into the following three groups: (1) The dextral group. This includes those who are both right-handed and right-eyed, with no trace of left-handed initiative. (2) The left-handed group. Predominant left-handedness here is characteristic and the typical performance score is the reverse of the dextral. The "master-eye" may be right or left. (3) The sinistral group. Actually, right-handedness predominates in this group, but some form of left-handed initiative is almost always present and there are many instances of so-called "ambidexterity." Some of these men consider themselves left-handed. The members of this group are dextrals by the performance test, but usually the left eye is the "master-eye."

At this point a case may be mentioned showing that a comparative test of manual dexterity may have useful clinical applications. The patient was a player of a stringed instrument (No. 21, Table 2) actively engaged in professional work. He proved to be right-handed and left-eyed, in other words, a "sinistral"; but, strangely enough, he made not only a low score with either hand but his score was also typically a left-handed one. These anomalous findings at once became clear when he made known that he had had some years previously a slight "stroke" affecting the right side.

PREVALENCE OF SINISTRALITY IN MUSICIANS

Four per cent. of the machinists proved to be left-handed (Table 3) and an additional 4 per cent. had sinistral peculiarities. In striking contrast to these figures, 8 per cent. of left-handedness was found in the series of musicians while the lesser forms of sinistrality mounted to the remarkable total of 24 per cent. Such an outstanding psychologic disparity between two groups of men in whose vocations a high order of muscle coordination is essential at once raises the question: Why is left-handedness twice and sinistrality six times more prevalent in one than in the other? I shall return to this point after an attempt to determine (*a*) whether left-handed musicians enjoy a physical advantage in comparison with right-handed players, and (*b*) whether instrumental technic modifies ocular dominance.

(*a*) Is left-handedness a physical advantage? In the series of professional musicians, sixty-eight are dextrals and thirty-two either left-handed or sinistral. Every grade of technical proficiency is represented in the 100 musicians, and seventeen enjoy high repute as soloists. It is significant, however, that only one of the soloists, an organist (No. 24, Table 2), is a sinistral. Twice I have heard left-handed musicians remark that they had "had to work hard" for their music, and from conversations on the subject with a number of others I get the impression that, in the acquisition of technic, they have had to overcome greater physical odds than dextrals. The fact that in the performance test the average sinistral score is lower than the average dextral score supports this idea. Such as it is, therefore, the evidence goes to show that muscle coordination is more highly organized in right-handed players and that left-handedness constitutes no physical advantage.

(*b*) Does instrumental technic modify ocularity? Left-eyed dominance is a common sinistral symptom in musicians. One might be led to believe from the figures in Table 1 that this peculiarity occurs with varying frequency in players of different instruments, but I believe these inequalities will disappear with more statistical material. It is true, however, that some musical instruments more than others require extensive training of the left hand. For example, one might infer that the difficulties of intonation in violin playing would have a tendency to concentrate attention on the left hand and on the left eye because this eye commands a more direct view of the strings. In fact, however, vision plays a very subordinate rôle in the technic of stringed instruments. If is safe to say that even in complicated phrases the finger movements are guided almost entirely by muscle and tactile memories.

But if it were true that violin technic fosters left-eyedness, the contrary should be characteristic of an instrument like the trombone, in the technic of which the left hand is almost inactive, tone modulation being produced through free movements of the right arm and hand. Yet five of the eight trombone players examined were definitely left-handed or sinistral. This seems to show that ocular dominance is uninfluenced by technical training. But left-handedness is a physical handicap. Why, then, are there so many sinistral musicians?

Of the three classes of men under consideration, from the standpoint of physical development the machinists easily take first place. The musicians come next because age disqualifies the relief-home group. But as most of these old men in their earlier years were active in various trades or as sea-faring men, it is probable that a leveling of the age element would force the musicians into third place. Such a readjustment, moreover, would be in harmony with the comparative sinistrality data of these three classes; namely, machinists, 8; relief-home inmates, 22, and musicians, 32. According to these figures sinistrality is a rare symptom in muscular hand-workers and common in artists. Thus an intimate relation appears to exist between left laterality and a type of mental organization prevalent in musicians. I would suggest that this is not a fortuitous association, but that both left-handedness and sinistrality usually are indicative of the psychopathic constitution. To be adduced in support of this view are these facts: 1. Left-handedness is hereditary. 2. It is probably due to defective organization in the central nervous system because of the concomitant occurrence of speech defects. 3. As several writers emphasize, it is common in children of low grade mental type. It follows that a high proportion of left-handedness in any class of the population is at least suggestive of mental instability and, I believe, of a peculiar susceptibility to the influence of music. Hence sinistrals feel drawn to the musician's vocation in spite of the fact that it is a vocation for which in many instances they are not well adapted.

PSYCHOLOGY OF LEFT-HANDEDNESS

It is coming to be recognized that disorders of speech are as common in the left-handed as they are rare in dextrals. But the fact seems to have been overlooked that such disorders also are common in those ostensibly right-handed people who are left-eyed. According to the figures in Table 2, the values in left-handed and sinistral musicians are about 60 and 20 per cent., respectively. A natural inference would appear to be that these clinical forms are essentially alike and differ in degree only. The left-handed man is prone to stammer and so is the right-handed man if he happens to be functionally cross-wired and uses his left eye for fixation purposes. Stier [5] is frankly noncommital as to the significance of left-eyedness. Citing Enslin, who experimented with right-handed and left-handed soldiers and found that while in the former the right eye was always dominant, in the latter the left eye was dominant in twenty out of fifty-eight, Stier observes: "Personally I myself make an exception, since, notwithstanding that I have excellent vision in both eyes, in the test referred to I have found in myself a preponderance of the left eye in spite of marked right-handedness. Further experiments with other persons have shown me that it is by no means easy to understand what this experiment (determination of the master-eye) indicates. A repetition of these tests in well-educated people rather than in soldiers is therefore to be recommended before we seek to explain this remarkable phenomenon." [6]

But other central nervous peculiarities occasionally are noted in musicians with left-sided dominance, and one of these is inability to solve problems in rhythm. Some of these men cannot play in perfect tempo. Unequivocal evidence on this point was obtained from four musicians (Table 2). Probably this shortcoming is more prevalent than these figures indicate as, for obvious reasons, musicians are apt to be reticent on this subject. None of the dextral musicians gave evidence of faulty rhythm. Still another manifestation of left laterality concerns the mental outlook. I have been strongly impressed by the fact that the left-handed and sinistral musicians are much more nervous and "temperamental" than the dextrals. Talkativeness, mutism, motiveless laughter, borderline depression states and in one instance a history suggestive of dual personality have been noted. Curious defense reactions arise through the inability of these persons to adjust themselves to a right-handed environment. They constitute a class of "square pegs" whose mental difficulties would merely be aggravated by psychanalysis. Elusive modifications of personality, associated with left-handedness, have been noted in the lives of men of extraordinary ability. Stephen Paget [7] gives a good illustration of this in his life of Sir Victor Horsley: "And he and Gerald had a way of pronouncing th as v. In the use of his hands he was absolutely ambidextrous: he had been left-handed to begin with. He could even draw on wood equally well with either hand. His movements were quick and purposeful . . . There are lives, and his was one of them, at which we are able to warm our hands: the pity is that so many people —it was more his fault than theirs—did not warm their hands but burned their fingers at his life." May we not here read a lesson in the life of a man of genius?

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[5] Stier, Ewald: Untersuchungen über Linkshändigkeit und die funktionellen Differenzen der Hirnhälften, Jena, G. Fischer, 1911, p. 302.

[6] Translation by the author.

[7] Paget, Stephen: Sir Victor Horsley, London, Constable and Co., 1919, pp. 263-265.

CONCLUSIONS

1. It is possible to differentiate established left-handedness from sinistrality by means of performance tests.

2. Both left-handed and sinistral musicians are prone to various forms of muscle incoordination and a defective sense of rhythm.

3. The combined values for left-handedness and sinistrality were found to be 8 per cent. in iron-workers, 22 per cent. in relief-home inmates and 32 per cent. in musicians.

4. Left-handedness and sinistrality usually are indicative of the psychopathic constitution.

5. Owing to the imperfect sense of balance which is so often to be noted in sinistrals, it is suggested that what is known as "the feel of the airship,"[8] probably is not as highly developed in sinistral as in dextral pilots.

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[8] Air Service Manual, Washington, D. C., 1919, p. 246.

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PEARCE BAILEY, M.D.

1865-1922

Obituary

PEARCE BAILEY, M.D.

In June, 1918, I heard Dr. Pearce Bailey make a report of the War Work Committee of which he was chairman. It told of what he, working with Dr. Salmon and Dr. Paton, had done during the previous year. It was a record of splendid achievements, and I felt that here was a man who had done something wise and notably worth while. It deepened tremendously my respect and friendship for the man. In this year of war work, methods had been outlined for treating and caring for patients with mental and nervous diseases, plans being made for neuropsychopathic hospitals, their equipment, administration and personnel. Later Dr. Bailey studied the methods that were being pursued in Canadian hospitals, and he utilized in his government service the experience there obtained.

A division of neurology and psychiatry was introduced into the army, and for the first time the importance of this kind of service was recognized at Washington. Dr. Bailey was made chief of this new division. Those who know his work there better than I say: "He built a new department and one of vast importance for the efficiency and morale of the army through the elimination of the mentally unstable and unfit. The ideas he effected in this work later were made a part of the psychological work undertaken by the armies of this country's allies."

Dr. Bailey was successful because of his quick and intelligent grasp of problems, because of his administrative skill, and perhaps most of all because it was seen that he was working unselfishly, and not for any personal gain. Entering the service in July, 1917, he was promoted to the rank of lieutenant colonel and finally to colonel, and was discharged from the service in February, 1919, with the Distinguished Service Medal.

He must then have felt that he had developed administrative skill, and his friends knew that he had wisdom, courage, broad vision and initiative. He was therefore urged by some of us to take the position of chairman of the New York State Commission for Mental Defectives, from which Dr. Walter B. James had recently resigned. He accepted the task and he proved again that he possessed the qualities needed for work in this new and difficult field. Governor Miller has given a spontaneous tribute to his efficiency. He said:

"Dr. Bailey was a man who possessed the very rare combination of public spirit, broad vision and practical common sense. And he was developing a sane and constructive policy in dealing with the problem of caring for and treating mental defectives."

The limited amount of space does not permit me to tell the whole story, but I wish to record that he succeeded for the first time in segregating the defective delinquents and in showing that mental defectives should not be treated with or as criminals any more than should the insane. His commissionership of defectives involved a good deal that was laborious or unpleasant, but he told me after a year of this work that he liked it and was going to continue. His literary skill and imagination helped him in the propaganda of his cause. A short time ago he published an article in a Sunday paper entitled "Shall We Murder the Children?" This was in reference to the fact that two adults of the mental age of 6 years had recently been executed for murder.

But his duties as commissioner took only part of his time, and he proceeded to work out a scheme about which he had long thought and written. This was the problem of the misfit or maladjusted adolescents. He recognized that a marked percentage of maturing lads in the preparatory schools and colleges were not getting on as they should. They were giving trouble to their parents and teachers; they were not, perhaps, bad or defective, but they were not suited to the demands of the ordinary educational schedule. They were dropped or expelled or sent to special schools. No serious and expert study had ever been made of their physical and mental condition or temperamental trends. Dr. Bailey said: "Let us look youth in the face. We will find that among those who are above the level of the moron there are great differences in intelligence and ability. All our boys and girls are not clever. Twenty per cent. of freshmen do not become sophomores; 15 per cent. of sophomores do not become juniors; 10 per cent. of our normal adult population are economic failures." These facts as to the varying capacity of our supposedly normal adolescents led him to organize the Classification Clinic which now exists and functions with a staff of men and women competent to analyze, and to try to solve, the problems of "difficult" children.

So much for the later activities of Dr. Bailey's career. It was during this period that he became one of the editors of the ARCHIVES OF NEUROLOGY AND PSYCHIATRY. He had really found himself, and death cut him down just when he was richly equipped for original and beneficent work.

Dr. Bailey was born in New York, July 12, 1865. He received the degree of Bachelor of Arts at Princeton in 1886 and was graduated in medicine from Columbia University in 1889. He studied abroad, much of the time in France. He was adjunct professor of neurology at Columbia from 1906 to 1910; consulting neurologist at St. Luke's, Roosevelt, New York, Orthopaedic, Manhattan State and St. John's hospitals. He was a member of the American Medical Association, former president of the American Neurological Association, New York; president of the New York Neurological Society from 1903 to 1905, member of the New York Pathological Society and Academy of Medicine. He was one of the founders of the New York Neurological Institute, in East Sixty-Seventh Street, where he devoted himself to hospital work for many years.

He married Edith Black, of New York, who died about ten years ago. He is survived by two sons and two daughters.

Dr. Bailey early achieved a position of distinction in neurology. His bent was toward neuropathology and organic neurology. But he became interested in traumatic problems and wrote, in 1898, at the urging of Dr. Starr, "Accident and Injury; Their Relations to Disease of the Nervous System." This work was well done. The volume might have been much larger and fuller, but I think Dr. Bailey felt that such works are never final and can never be complete. He gave it the amount of space that was due the topic at that time.

Dr. Bailey wrote many articles on neurologic, psychiatric and allied subjects. His most numerous contributions were to organic neurology and to its traumatic and surgical phases. These articles all have value and contribute to our store of knowledge. I think that his articles touching on neuropsychiatry and social problems are now the more interesting, and they can be read with profit for a long time. "Faith Cures," "Crime and Defectives," "Efficiency as a Medical Problem," "Expert Testimony," "War's Big Lesson in Mental and Nervous Disease," "Neurology and Internal Medicine," were some of his themes. His article on "Voltaire's Relation to Medicine" is an interesting and real contribution to history.

It is an interesting fact that Dr. Bailey did so much important work characterized by originality, initiative and facile receptivity of mind after he was 50 years of age.

Dr. Bailey had an acute intelligence and saw quickly the whole of a problem to the very end. In fact, his quickness of comprehension led him to see that certain things which appeared important were really not worth while; this gave him a reputation for taking up and dropping things very quickly. He was, however, tenacious enough in matters which he saw were fundamentally interesting and worth while.

Dr. Bailey did not have a pedagogic mind, and I think he never cared deeply for teaching. He had a clear, convincing style, however, and could present a topic admirably. He was not a controversialist, but he knew well how to conduct propaganda; instead of arguing, he expounded.

His manner was rather reserved; he was one of the so-called "linear" type—a person with strong emotions, held under good control. Dr. Walter James said that Dr. Bailey was the kind of person one liked better at the second meeting. He possessed humor and wit, and though apparently serious, he was always ready to break into merriment. In spite of his reserve of manner, he had many friends because of his cultural interests, his social qualities and his personal worth, and I doubt that he had enemies. Dr. Bailey had that peculiar quality which enables one to love persons one does not altogether like; "He does terrible things, but I am very fond of him," he would say. He was fair-minded and just in his estimate of men and character.

His talents as a writer of imaginative prose were of a high order; he might have been one of our leading story writers and dramatists. His trend was especially to the dramatic, and his tales ended with a thrill. That at least was the style of literature he gave us at the meetings of the Charaka Club, of which he was a charter member, and in whose volumes are some of his best tales.

Dr Bailey had many friends outside of the medical profession, who recognized his talents and social qualities. His prominence and success in his army work, his activities as commissioner, his new and courageous venture into the adolescent problem, all had conspired to give him unusually wide prominence and importance. The sadness of his domestic life, the loss of his brilliant wife, leaving four young children, had also made his friends feel an especial tenderness toward him.

His death is felt widely and keenly and in a way that I cannot adequately portray. At a meeting of the Charaka Club on February 15, Dr. Peterson offered a resolution which expresses with a personal touch what I would like to say in conclusion.

"Pearce Bailey was one of our founders, one of our best beloved members. During many years his intellect, his wit and his humor have lent a charm to our gatherings which will be sadly missed. We respected and admired him for his integrity of character, his fearless independence of thinking and for the quiet courage with which he bore many sorrows. His fine and striking personality always made itself felt. What he wrote for us was unique in its style, in its keen psychologic analysis and dramatic finish. He has an enduring place in our hearts."

CHARLES L. DANA.

Abstracts from Current Literature

THE RELATION OF THE CEREBROSPINAL FLUID TO THE CIRCULATION OF THE BLOOD AND TO THE NERVOUS ELEMENTS OF THE CEREBROSPINAL AXIS. L. Stern, Schweiz. Arch. f. Neurol. u. Psychiat. **8**:215-232, 1921.

While the cerebrospinal fluid has been made the object of numerous researches, the conclusions reached have not always been in harmony. For example, there is still a great deal of discussion as to the exact course of the cerebrospinal fluid within the nervous structures. According to Goldman, the perivascular space of Robin serves as a lymphatic pathway, communicating on the one hand with the pericellular spaces of Mott and on the other with the subarachnoid cavity. As to the nature of cerebrospinal fluid there is also a difference of opinion, some considering it a secretion of the choroid plexus, others a product of filtration or dialysis of the blood plasma.

The physical properties and chemical analysis of the normal fluid are then reviewed in detail. From the standpoint of chemical analysis alone, it seems unlikely that the cerebrospinal fluid can be considered closely related to the blood plasma. Of all liquids in the animal organism, only the aqueous humor of the eye and the fluid within the ear present any resemblance to the spinal fluid. The analogy becomes closer from both physiologic and teleologic standpoints as these fluids find themselves in immediate contact with nervous elements and in all probability play a similar rôle. The pertinent question arises as to whether this fluid is concerned with the nutrition of the nervous elements.

The writer has long been interested in the permeability of the choroid plexus to various substances. The literature is replete with contributions reporting the passage of diverse substances from the circulation into the cerebrospinal fluid. For the most part, however, these cases have been pathologic and alterations in the vessels and meninges could not be excluded. Experiments on normal animals have been relatively few.

Stern investigated this subject by the following method: In order to prevent the rapid elimination of substances introduced into the general circulation through the kidneys and to increase their concentration within the blood, a double nephrectomy under ether anesthesia was done on dogs, cats, rabbits and guinea-pigs. The substance to be examined was then injected intravenously, under the skin, or into the peritoneal cavity. After varying periods of time the animal was killed by bleeding, and the blood, the cerebrospinal fluid, and the nervous tissues were examined by chemical and biologic methods.

It was found that sodium bromid injected into the general circulation was regularly found in the spinal fluid and in the nervous tissue within seventy-five minutes. The concentration of this salt in the fluid was twice as great as in the nervous tissue and half as great as in the blood. Sodium salicylate, injected in a similar manner, was found in the spinal fluid and in the nervous tissues at the end of an hour. Sodium sulphocyanate was found in less concentration in the spinal fluid than in the blood but in greater concentration than in the nervous tissue. Sodium picrate was found in the spinal fluid and in the nervous structures of all the animals, except in those of the rabbit in which there was remarkable inconstancy. Strychnin could be discovered in the spinal fluid and in the nervous tissue as early as twenty minutes after injection into the general circulation; the concentration was greater in the nervous structures than in the blood which could be explained only by assuming a definite affinity of this alkaloid for the nervous structures. Morphin was found in the spinal fluid and in the nervous structures at the end of eighteen minutes. Atropin was also found, however, in smaller concentration than in the blood; the results differed in the dog and in the rabbit. Santonin was found in the spinal fluid and in the nervous tissue after intraperitoneal injection. Sodium iodid and sodium ferrocyanid could be discovered neither in the spinal fluid nor in the nervous tissues regardless of the dosage or the method of administration. The same applied to curare. Among the dyes injected, eosin gave a negative result. Fluorescein was not discovered in the spinal fluid, while the choroid plexus was intensely stained and greatly distended. Uranin was not found in the spinal fluid, nervous structures, or even in the choroid plexus; however, intense fluorescence and deep staining were noted in the aqueous humor of the eye on the same side that it was injected into the carotid artery. Methyl violet gave discordant results; it is interesting to note that such substances as sodium iodid and sodium ferrocyanid which normally do not penetrate, when injected simultaneously with methyl violet were regularly found in the spinal fluid and in the nervous tissues whenever the methyl violet penetrated, but were not found in these structures when the dye did not penetrate. According to Veneziani, methyl violet may produce alterations in the choroid plexus leading to the arrest of spinal fluid production. It was impossible to decide whether epinephrin circulating in the blood was prevented from entering the spinal fluid or whether its absence in this liquid was due to its destruction. Bile pigments could not be demonstrated in the spinal fluid either following injection of bile into the general circulation or following ligature of the bile ducts; on the contrary, bile salts were found in the spinal fluid either following injection of bile or ligature of the bile duct. It is possible, therefore, that it is the bile salts rather than the pigments that produce some of the nervous phenomena noted in grave cases of icterus. The search for antibodies in the spinal fluid gave negative results; neither cytolysins, neurotoxins, nor precipitins could be demonstrated in the spinal fluid of immunized animals.

The "hemato-encephalic barrier" is supposed by Stern to functionate in a physiologic rather than an anatomic manner. The exact mechanism is not fully understood. It was a striking fact that whenever a substance introduced into the general circulation was found in the spinal fluid it was also found in the nervous tissues. Furthermore, no substance found in the nervous tissue could not be demonstrated in the spinal fluid. Once they entered the spinal fluid they rapidly found their way into the nervous structures and, if the substance introduced was toxic or irritating, grave symptoms appeared at once. In fact, introduction into the spinal fluid was followed by more certain results than the direct application to nervous structures.

According to the work of Goldmann, the injection of trypan-blue into the subarachnoid space by the vital staining method shows penetration of the brain substance to the nerve cells. The spinal fluid consequently enjoys the same rôle in the metabolism of the brain that the lymph does in that of the cells of the organism. The general course that these substances take would be from the blood into the ventricular spinal fluid, thence through to the ventricular structures into the nervous parenchyma, thence to the subarachnoid spinal fluid, and finally back into the blood.

Woltman, Rochester, Minn.

SCLERODERMIC DYSTROPHIES. Hans Curschmann, M.D., Med. Klin. **17**:1223 (Oct. 9) 1921.

It is Curschmann's belief that the dominating symptom of a dystrophy may be a sclerodermic manifestation. He reports six cases; the first in great detail. A man, aged 42, with a negative family history, was unable to complete school because of mental deficiency. Since puberty, he had had infrequent epileptic attacks. At the age of 19, he developed swelling and tingling of the fingers with pain and gangrene. Gradual thinning of the fingers, induration of the skin and stiffness of the joints developed. Of late years, the gangrene had subsided, the pains had disappeared and the former sweating of the hands had ceased. With the changes in the fingers, painless loss of the teeth occurred. Recently, the patient complained of increasing weakness, loss of libido, constipation, tachycardia and dyspnea.

The hands showed classical sclerodactylia, with evidence of residual Raynaud's disease. The head was small; the nose was long and thin; the skin of the forehead was fine, with many folds. Over the face were many small telangiectases. The hair was thin and the beard was spare. The blood pressure ranged from 85 to 90 systolic, the pulse varied from 60 to 64. The blood picture showed from 9 to 18 per cent. eosinophils. There was no free hydrochloric acid.

The neurologic findings beyond the epilepsy and feeblemindedness were essentially negative. A roentgenogram of the hands revealed atrophy of the distal phalanges.

Skin tests with morphin and epinephrin showed marked delay in reaction, which was mild and transitory.

The patient thus presented a syndrome of sclerodactylia and scleroderma of the face, anhidrosis, loss of teeth, poor sexual development, impotence, pigmentation, adynamia, achlorhydria, continued low blood pressure, eosinophilia, epilepsy, apical tuberculosis and progressive cachexia, which was the most striking of all the symptoms.

Curschmann speaks of this syndrome as a dystrophy with signs of pluriglandular deficiency, in which the scleroderma is a coordinating symptom. He does not consider this an unusual syndrome and he believes that the more we look upon symmetrical scleroderma as a syndrome of glandular function, the more frequently will we see this picture. It is the author's belief, both from his own observation and from the observation of others, that scleroderma is usually associated with a more or less general dystrophy.

The frequency of these "sclerodermic dystrophies" is shown by the occurrence of seven cases in Curschmann's clinic during the past two years.

Five other cases are reported in some detail, the outstanding features being scleroderma, achylia, pigmentation, hypotension, usually eosinophilia and general cachexia. The pluriglandular symptoms vary from case to case; at times there are definite changes in sexual characteristics or these may be absent. Tetany is not an unusual finding, and may be attributed to the parathyroid. One patient had typical tetany attacks in the hands with bronchial asthma attacks.

C. von Noorden described a condition called "degeneratio genitosclerodermatica" in his work on chlorosis, in which he considered it to be an equivalent of chlorosis. Von Noorden's cases were in previously healthy women who, following an acute infection, ceased menstruating; became weak and cachectic; presented hyperglobulia; indigestion, especially pancreatic;

trophic disturbance of the fingers ("Glanz finger"), etc., and finally developed scleroderma. Pituitary disturbances also might appear.

In this "young girl" type of pluriglandular deficiency, the scleroderma is relatively late and not a striking symptom—a characteristic example of a symptomatic scleroderma. The scleroderma may be entirely absent, the disease process then being called Noorden's disease. Curschmann has described such a case without any scleroderma.

If one considers von Noorden's type and the numerous other forms described in the literature in which the thyroid, pituitary, suprarenal and other endocrine symptoms may occur, with the type of cases described by the author, it is Curschmann's belief that the use of a general term, such as sclerodermic dystrophies, is more applicable than the attempt to establish a single glandular agent as the causative factor in some special case.

In attempting to determine the etiology of this sclerodermic change, it seems self-evident that no single general cause can be held responsible. It is doubtful that it is the result of a pluriglandular change; it seems more rational to attempt to find a cause for both the pluriglandular change and the scleroderma as they seem coordinated. This search would lead to the sympathetic or parasympathetic system of both cerebral and spinal origin. Just how the sympathetic system is altered, whether by toxins or infections, remains a question.

The assumption that the pluriglandular changes and the scleroderma are coordinated results of a sympathetic disturbance is of special interest because of late many workers are attributing to the skin endocrine functions. These properties of the skin, as in other dystrophies with pluriglandular syndromes, in vasomotor and trophic neuroses, etc., present a new problem which will require further investigation.

Moersch, Rochester, Minn.

EUGENICS AS A FACTOR IN THE PREVENTION OF MENTAL DISEASE. Horatio M. Pollock, State Hosp. Quart. **7:** No. 1 (Nov.) 1921.

Inheritance of the neuropathic constitution may be taken for granted. Much evidence has been adduced to prove that such inheritance occurs in accordance with mendelian laws, but the subject is so complicated that more comprehensive studies need to be made before we may consider the matter as settled. The application of skilfully devised measures of intelligence has shown us that there are many grades of intelligence between the idiot and the superaverage. The so-called normal persons represent many types, the extremes of which are as far apart as the moron is from the low-grade normal person. Recent studies of temperamental abnormalities have also revealed a wide variety of types and combinations. These abnormalities or marked peculiarities seem to be more or less dissociated from intellectual capacity. Children with superaverage intelligence are frequently seclusive and morons often seem to be temperamentally normal. It becomes difficult, therefore, to establish standards of normality and to draw fixed lines between the normal and the neuropathic state. This is especially true in studying family histories when judgment must be based on reports of untrained observers.

The data collected by the New York State Hospital Commission relative to family history seems to indicate that slightly more than half of the ascertained cases have no discoverable hereditary basis. If more thorough inquiries were made the proportion of patients with an unfavorable family history might be increased, but the significance of the history in relation to the family stock is open to question in many cases.

In New York state hospitals for some years past have been studied both the intellectual and temperamental makeup of patients admitted for the first time. In 1920, it was found that of the ascertained cases 61 per cent. were temperamentally normal and 88 per cent. were rated as intellectually normal. Only about 7 per cent. of the patients were both temperamentally and intellectually abnormal. The proportion of patients with an abnormal makeup varied considerably in the different groups of psychoses. For example, in the dementia praecox group in 1920, 61 per cent. were rated as temperamentally abnormal while in the manic-depressive group only 33 per cent. were so rated.

The absence of marked abnormalities prior to the onset of the psychosis cannot be construed as conclusive evidence that there are no hereditary defects in the makeup, neither can the development of the psychosis be taken as proof of a defective constitution. All the facts in connection with the onset of the mental disorder and previous reactions must be brought together before the constitutional makeup of the patient can be positively determined.

Notwithstanding these and many other complications, there is abundant evidence that mental disorders occur much more frequently in some family stocks than in others and that prolonged inbreeding of degenerate stocks is productive of most disastrous results.

With the limited knowledge at hand, what is to be done to lessen the burdens imposed on society by the prevalence of mental disease?

Three lines of action are suggested:

1. Environmental stresses may be lessened and natural resistance strengthened.

2. Procreation of defective stock may be checked.

3. Procreation of normal stock may be increased.

Economic and social stresses should be lightened for those unable to withstand them. It is far easier to relieve an overburdened man by taking part of his load than to wait until he is exhausted and then carry him together with his burden. Physicians, parents and teachers should be alert to detect signs of mental disorder and apply the proper remedy before complete breakdown occurs.

Segregation of the mentally defective and epileptic is the prevailing method of limiting procreation among these classes. Its eugenic value is beyond question, but the enormous cost limits its application. As a rule, mental defectives and epileptics cared for in institutions are of low grade. These, if left at liberty, would multiply far less than those of higher grade. Much is to be hoped from the colony plan of segregating mental defectives, as colonies care for high grade defectives and under wise management become self-supporting and may be increased without limit.

A new departure has been made by the state of New York in establishing a separate institution for defective delinquents at Napanoch. This troublesome group has been a serious problem in the jails and prisons of the state and heretofore there has been no satisfactory way of dealing with them. Their segregation should have great eugenic significance.

Something can be done to lessen reproduction among the unfit by enlightened public sentiment and by better marriage laws. Marriage of persons with marked intellectual or temperamental abnormalities should be prohibited.

To prevent the marriage of normal persons with those carrying a neuropathic taint more knowledge of family stocks must be made available. At the present time genealogic records of the average family are wofully meager and comparatively few are available for public inspection. If we are to improve the race by better marriages genealogic or eugenic bureaus must be established in cities and villages. Data concerning family stocks should show the defects as well as the excellencies and achievements of the individuals recorded and be available to interested parties.

Bailey, New York.

REPORT OF A CASE OF OPTIC APHASIA AS A CONTRIBUTION TO THE MECHANISM OF SPEECH DISTURBANCES. Heinz Fendel, Berl. klin. Wchnschr. No. 38, 1134 (Sept. 19) 1921.

The author reports in detail a case of optic aphasia and illustrates his statements by the use of a diagram taken from Liepmann.

Little advance has been made in recent years in the study of speech mechanism, and Fendel believes that by carefully studied clinical cases much can be hoped for. Anatomic experimentation has proved to be practically useless. The psychologists who have attempted to compare periods of speech development with types of aphasia have found what seem to be insurmountable barriers.

Injury to Wernicke's center or disturbance in association fibers with this center are, in the opinion of the author, the bases for all aphasic disturbances.

The case reported is one of optic aphasia, associated with a right homonymous hemianopsia and pure verbal alexia, with no sensory aphasic disturbances. The patient was a woman, aged 45, who on Feb. 18, 1921, was brought to the hospital in a stupor following a severe erysipelas. When aroused a monophasia was distinguished; she always replied in a senseless manner "da-da-da-da." Examination when feasible showed a peripheral arteriosclerosis; the systolic blood pressure was 160. Urine, blood and spinal fluid were normal. The neurologic examination was negative except for right homonymous hemianopsia. The fundi were negative. A preliminary diagnosis of thrombotic softening in the left occipital region, arteriosclerotic in nature, was made.

Examination of the speech mechanism showed that understanding of speech was intact. Motor commands were executed promptly, repetition unimpaired and spontaneous speech normal. The patient was unable to name recognized objects. When shown a key, she gave evidence of recognizing the object but could not recall its name. When asked, "With what do you lock the door?" the word key was given at once. In this case tactile sense did not help to arouse the visual word image, but auditory sense frequently did. Thus, although she could not name a watch, she immediately recalled the name of the object when it was placed to the ear; this was also true of other objects. With considerable practice the patient regained some ability to name commonplace objects.

The patient was unable to read, could name single letters and by spelling was able to name words. She could not appreciate written commands. Isolated figures were read correctly, and she was able to write and print but with numerous mistakes. Dictation writing was much better but also showed mistakes. Single letters could be copied, but the patient was unable to write names of objects or words without errors.

During the two months of observation the only improvement noted was the patient's ability to name everyday objects. In attempting to explain this speech disturbance the author assumes the presence of a lesion in the posterior portion of the temporal lobe. All cases of optic aphasia at necropsy have shown a lesion in this general position where the auditory association fibers and the optic auditory commissural tracts converge.

Optic aphasia is truly an optic-auditory conductive aphasia, the centers themselves remaining intact. Oppenheim has seen only one case of word deafness.

The early monophasia in this patient is attributed by the author to the apoplectic affection which extended beyond the borders of the anatomic lesion.

In attempting to determine whether the loss of object recognition and loss of reading is due to disturbance of one or both optic centers, Fendel states that Déjerine and Ferrier assume that only the left center is able to recognize letters. In this case the left center is cut off from the periphery and to arouse optic memories there must be some connection with the right center. If it is assumed that the commissural tract between the visual centers is intact, then also the association tract between the visual center and Wernicke's area on the left side must be intact. Fendel assumes that the connection of the right visual center and the left Wernicke zone was left intact and that by this means the patient was able to accomplish the reading of single letters, but was unable to read complicated words or name objects.

The pure verbal alexia in this instance was not a disturbance *sui generis*, but a mild total alexia, or it might be called a dyslexia. The right hemianopsia was not followed by loss of color sense; therefore it seems to the author that the right hemisphere is not only for object recognition and color recognition, but also for certain object quality recognition.

The author admits that much which has been propounded is theoretical. Numerous other queries are made, and he attempts to answer them. He admits, however, the difficulties that are encountered in any explanation and ventures the hope that more intensive work may help to elucidate some of these interesting phenomena.

Moersch, Rochester, Minn.

A PRESENILE DISEASE RESEMBLING PSEUDOSCLEROSIS. Constantin Economo and Paul Schilder, Ztschr. f. d. ges. Neurol. u. Psychiat. **55**:1, 1920.

The authors relate the case of a man whose illness began in the fiftieth year and continued with remissions for five years, when he finally died in a remission lasting five months. Clinically the picture was one of increasing muscular rigidity with occasional periods of mental confusion. His last attack was marked by staring face and eyes, difficulty of movements of eyeballs outward and downward, half opened mouth, dysarthria and explosive speech, dysphagia and rigid lower extremities in extension which were adducted and internally rotated. The tendon reflexes although masked by rigidity were present. There were no pathologic pyramidal tract reflexes. In the strict sense, paralysis or paresis was absent. Neither was somatic sensation affected.

The rigidity was characterized by the following special features: There was an appreciable latent interval before voluntary effort could initiate movement. When such movement was established it would be arrested by a recurrence of the rigidity which affected agonists and antagonists alike. Passive motion, if made gently, would tend to relax the rigidity; if brusquely, would tend to increase it. As in a normal case, resistance applied against movement in an extremity would be followed by the rebound phenomenon when such resistance was suddenly released. One rebound would be followed by another, the extremity going through a sort of pendulum movement. Tendency to associated movements was expressed by an increase of rigidity in the general musculature when the rigidity was increased in one extremity. At rest form tonus was increased.

The exitus was accompanied by tonic extension of the upper extremities. At necropsy an acute bronchitis was found and a cardiovascular nephritic degeneration of mild degree. The brain showed a slight chronic internal hydrocephalus. Macroscopically the liver was negative. The histopathologic examination of the nervous system revealed the following lesions:

Cerebral Cortex: Fat in the ganglion cells was increased, and also the number of satellite cells, especially in the deeper layers of the cortex. These changes were not marked, but they exceeded the changes normally found at the age of the patient.

Cerebral White Matter: The small glial elements and degeneration products about the vessels were increased.

Basal Ganglions: In the basal portion of the corpus striatum and neighboring parts of the substantia innominata there occurred a diffuse glia cell increase of small lymphocyte-like cells rich in chromatin and revealing no protoplasmic ring with the methyl green—pyronin stain. In addition there was an increase in glial fibers. The globus pallidus showed large and small accumulations of degeneration products in the media, about the endothelium of the capillaries and also free in the surrounding tissues. It was determined that these masses contained both fat and protein.

Cerebellum: The most noteworthy finding was a high grade intracellular fatty deposit in the molecular layer of the cortex.

The spinal cord was not examined.

The liver showed a moderate interstitial hepatitis.

Preliminary to a discussion of the classification of this case, which they believe to be a distinct affection, the authors review the literature of pseudosclerosis and allied clinical forms, including Wilson's disease. The criticism is made that in Wilson's article an insufficient analysis and characterization of hypertonus is made. Sherrington's classical experiments of decerebrate rigidity are reviewed and application made to the forms under discussion. The authors accept as a fact that striatum lesions produce hypertonus, admitting, however, that in certain cases the mechanism may be produced by cerebral decompensation. Two cases reported by Woerkom, occurring in the praesenium without a heredodegenerative or constitutional basis, are most closely related to the personal case of the authors. The closely related entities of paralysis agitans and atrophia-olivo-pontocerebellaris are discussed from a differential standpoint.

Anatomically in the reported case there are certain distinguishing features. The glial increase in the corpus striatum and the characteristic small-celled glia are contrasted with the large-celled glia found in pseudosclerosis. From Wilson's disease it differs by the absence of any disintegration of the lenticular nucleus. The cerebellar changes are without analogy. Nosologically the case is also distinguished from pseudosclerosis and Wilson's disease.

SCHALLER, San Francisco.

BROMID DELIRIUM. BEN KARPMAN, State Hosp. Quart. **7**:66 (Nov.) 1921.

The symptoms of bromid delirium have a varied psychotic picture which has much in common with the pictures of many psychoses. The marked intellectual disturbances with secondary affective deterioration, incapacity for complicated thinking, the defective and incoherent speech, diffuse defects in memory and retention with consequent disordered understanding of the environment, appear as evidences of diffuse cortical degeneration and thus bear a strong family resemblance to organic psychoses, such as general paralysis or arteriosclerotic dementia; although, as suggested by Hoch, in delirium there is more of a weakness than an actual loss and the disorder is transient, acute and recoverable. At the same time the undoubted presence of pressure activity, emotional instability, alternating excitement and depression, destructiveness, distractibility, and flight of ideas suggest strongly an underlying affective mechanism that closely resembles the manic-depressive psychoses. On the other hand, there stand out dissociation from reality, hallucinations and delusions, dream-like experiences, stuporous states, intellectual impairment, manifest disharmony between the intellectual content and its affective expression, bringing it close to the trend reactions such as we observe in the dementia praecox group. It is thus clear that the presence in delirium of a mixture of organic, affective and trend reactions precludes the possibility of grouping it with any one of these types of reaction. But we may approach the subject in another way. We may classify the deliria not on the basis of symptoms and reaction, but on the basis of etiology and content. We may group certain deliria showing affective or trend reactions and call these psychogenic in contrast to the organic deliria for which we can claim a physical basis; meaning by psychogenic such disturbances as are clearly the result of, and lie properly within the field of, mental activity and could not be conceived as arising otherwise. It is, however, an inadequate and poorly directed mental activity; the patient finds himself face to face with an unbearable situation to which he cannot or will not adjust himself, and instead of trying to solve the problem, he runs away from it and develops a psychosis, the outstanding feature of which is the unconscious and symbolic striving for the realization of the ungratified wish. But we know that in many toxic deliria also symbolic representations of wish fulfilments are frequently observed; hence, we cannot separate the psychogenic from organic deliria even on the basis of content, for although the latter may vary in strength, these deliria are obviously the same in character. It thus appears that infectious and toxic agents in organic deliria and mental causes in psychogenic deliria produce their effect in much the same way—through intoxication and exhaustion. In psychogenic delirium mental causes have brought about the exhaustion and clearly dominate the entire picture of the psychotic episode, which would not have taken place were it not primarily for the mental causes; in other words, the psychogenic factor is a disease symptom as well as an etiologic agent, whereas in toxic delirium the toxemia simply awakens the deep seated conflicts and strivings that have heretofore been lying dormant. But if we bear in mind that even in deliria with a toxic etiology, the mental make-up and attitude of the patient have, to begin with, determined the susceptibility to intoxication as well as later determining the manifest expression of it, it will become obvious that the toxic agent has entered here merely as one of the factors in the etiologic constellation and that neither on the basis of reaction or symptoms, nor on the basis of etiology and content is there an inherent justification in separating deliria into psychogenic and organic. They are all essentially the same in nature and content, they all have the same nucleus—the specific delirious alteration of personality which is characteristic of the particular person and is symptomatic of the difficulties under which he lived.

But whether or not we separate delirium into groups and types, the diagnosis of delirium is, as a rule, not difficult. The differential diagnosis, however, is not only difficult but often quite impossible for the reasons given; yet it is obviously important since the prognosis depends essentially on the etiology. Specifically, in our instance we find that no clear cut differentiation can be drawn in bromid delirium from other deliria and the differential points offered here are merely suggestive.

From delirium occurring in the course of infectious diseases, the bromid delirium may be largely differentiated by the lack of febrile and infection symptoms, and by the eruption usually present. An intense toxemia, with the patient lying in bed in a condition of lethargy and stupor, carphologia, low muttering delirium bordering on coma, gives us a clue to a typhoid type of delirium.

From exogenous psychoses such as develop as a result of using chloral, cannabis indica, paraldehyd and other drugs, the differentiation is quite impossible, since they all present practically the same clinical picture.

Pollock, Albany, N. Y.

A CONTRIBUTION ON THE PATHOLOGIC ANATOMY OF POST-HEMIPLEGIC ATHETOSIS. H. Steck, Schweizer Arch. f. Neurol. u Psychiat. 8:75-85, 1921.

Recently several contributions have appeared which concern the so-called extrapyramidal, or striate, disturbances of motility. The following report is based on the examination of a case reported by von Monakow in the second edition of "Gehirnpathologie," as a typical example of pure posthemiplegic athetosis, which he had the opportunity of following for twenty years:

Mrs. K. B., aged 67 years, with a negative family history, was perfectly well until the age of 27, when she suffered a left-sided stroke, following which there was residual weakness of the left arm and leg. At the age of 44, she suffered a left-sided hemiplegic stroke with loss of consciousness and some disturbance of speech. Almost complete improvement followed. At the age of 64, she had a third stroke, with partial recovery. Abnormal movements were said to have followed the first attack; these disappeared later. However, intense pain, in the left half of the body, particularly in the arm and shoulder, persisted. After the second stroke, involuntary, slow, irregular movements appeared in the left arm and fingers, and in the left leg and foot, which, except during sleep, continued uninterruptedly. There was a mild paresis of the muscles of the left side of the mouth; the left leg was paretic and somewhat abducted, with increased muscular tonicity; there was dorsal flexion of the left great toe. It was quite impossible for the patient to arrest these characteristically athetoid movements, even momentarily. There was a slight diffuse atrophy of the left arm and leg. No demonstrable loss of sensibility, save slight disturbance of stereognosis, was present. The patient was able, at times, to move some of the muscles voluntarily; however, this had to be done at a time when that particular muscle was not involved in the athetotic movement.

Necropsy revealed some interesting findings. There was a mitral endocarditis, and these changes in the nervous system: The dura showed no change on its external surface; but on its internal surface, over the left side, it was covered with a thin layer of brownish blood pigment. There was marked edema of the pia. The gyri were comparatively small, the sulci broad; however, there was no noteworthy asymmetry in comparing the two halves. The contour of the left lateral ventricle was normal; but on the floor of the right ventricle could be seen several gray-white depressions, one of which was present over the head of the caudate nucleus, and a second over the latero-anterior portion of the optic thalamus. On incision a smooth walled cyst, about 1 cm. in diameter, was found in the head of the caudate nucleus and another, 2.5 cm. in diameter, in the left lenticular nucleus and impinging on the middle and posterior portion of the internal capsule and of the optic thalamus. The arteries of the base were delicate and without pathologic changes. Unfortunately, only the right half of the brain stem was preserved; the anterior portion was fixed in Mueller's fluid, embedded in celloidin, and frontal sections were made, which were stained by the Weigert-Pal method and with carmin. The posterior half, containing the nucleus ruber, was stained with toluidin-blue and carmin.

Microscopic examination demonstrated that both cysts communicated through a rent in the small intervening membrane. The smaller of the two cysts was located mainly in the caudate nucleus, while the ventral one lay entirely within the putamen, impinging on the internal capsule. The walls of the cysts were of a brownish-red color, from 1 to 2 mm. thick, and contained no nerve cells, but showed a slight increase in glia cells. In the remaining portions of the caudate nucleus and the putamen, an occasional nerve cell could be found. The myelinated fibers passing through the putamen were diminished in number and in their stead there was an increase in glia cells. Shrinkage, tigrolysis and satellitosis of the remaining nerve cells bespoke an early degeneration. In the posterior portion of the globus pallidus could be noted a definite rarefaction with disappearance of some of the larger nerve cells; the anterior part was normal. Secondary degeneration was evident in the lenticulocaudate fibers passing through the internal capsule. The pyramidal tracts, however, so far as examination permitted, were nowhere diminished in volume. The corpus Luysi was normal, as were the substantia perforata and the red nucleus. The thalamus showed some cellular disintegration of the lateral and ventral but not in the medial nuclei. In brief, there was extensive degeneration of the body of the caudate nucleus, partial destruction of the anterior portion, complete destruction of the middle, and partial destruction of the posterior third of the putamen and some disturbance of the lenticulostriate portion of the internal capsule; the medial portion of the thalamus, the red nucleus, the substantia perforata anterior, the locus niger, the peduncles and the pons were normal.

The finding of note in this case is the complete preservation of the red nucleus and the apparent integrity of the corticopallidal fibers described by Déjerine. The correlation of cases reported in the literature is difficult. It is well known that there are cases reported with lesions in these portions of the brain that are not associated with athetosis. In fact, of eleven patients with lesions in these areas in which Steck had the opportunity of conducting a necropsy, only one had athetotis, three had tremor, a fourth rigidity; the remainder were normal. This would indicate that disturbance of the striate body can result in very different pictures.

In comparing cases of posthemiplegic chorea and athetosis, which have been reported clinically and pathologically, a difference in localization of lesions becomes apparent. Cases of hemiplegic athetosis resemble those of athetosis double in their relation to lesions of the striate body, while cases of posthemiplegic chorea show no striate lesion, but show a lesion of the brachium conjunctivum. A detailed discussion of the clinical pictures and the underlying anatomic findings would, at present, be premature and unconvincing.

Woltman, Rochester, Minn.

THE CEREBROSPINAL FLUID IN SYPHILITIC PSYCHIC DISTURBANCES. Sigurd Dahlström and Sofus Widerøe, Ztschr. f. d. ges. Neurol. u. Psychiat. **72**:75 (Oct.) 1921.

This is an important contribution to the problem of the communication of the spinal fluid in the different loci of the cerebrospinal fluid system. The authors call attention to the fact that in syphilitic diseases of the central nervous system it is not unusual to find that the serologic, cytologic and chemical constituents of the fluid from the ventricle and lumbar sacs differ. Thus in a group of seven cases they indicate the difference as shown by the Wassermann reaction, cell count, albumin and globulin reactions in these two loci. They endeavor to determine whether there is any communication between these two areas. For this purpose they have used two methods: one, the injection of neutral phenolsulphonephthalein in the lumbar sac and also in the brain ventricle. The second method is the injection of air after the technic of Dandy. One half hour after the intraventricular injection of 1 c.c. of phenolsulphonephthalein they were able to regain it from the spinal fluid in the six cases in which it was attempted. The more fluid that was withdrawn from the lumbar sac, the redder it became. In one case 1 c.c. of phenolsulphonephthalein was injected into the lumbar sac. About five minutes later a ventricular puncture was made and 15 c.c. of fluid were withdrawn in three tubes, 5 c.c. to each tube. The first tube was weakly colored, the second more strongly colored, and the third showed the most dye. They concluded from this that passage from the lumbar sac upward is possible. Two hours after the injection of phenolsulphonephthalein into the cerebrospinal system, the bladders in all six of the patients were catheterized and the urine tested for the dye. In two cases no dye was obtained, in three, from 2 to 3 per cent. only, and in the sixth, 8 per cent. was obtained. They call attention to the small amount that came into the urine in these syphilitic cases, being much less than the quantity Dandy has given as normal. They also injected air, according to the method of Dandy, into the ventricles and into the lumbar sac at different times. As regards the lumbar injection, they record and show roentgenograms made at the time to prove that the air was easily pushed up into the cisterna magna and lateral ventricles to the cisterna chiasmatica and also over the surface of the brain in what must have been the arachnoid space.

Solomon, Boston.

DEVELOPMENT AND REACTION OF THE PLANTAR REFLEX UP TO THE AGE OF TWO YEARS IN BABIES BORN BEFORE TERM. H. Bersot, Schweizer Arch. f. Neurol. u. Psychiat. **8**:46-74, 1921.

The previous section of this article was abstracted in these columns. Bersot reviews many of the points that he made previously and lays emphasis on the fact that the two fundamental characteristics of the plantar reflex, as seen in early life, are the variability of muscular responses in the feet themselves and the production of associated movements. Among the reactions, extension of the great toe was relatively more constant than movement of the interosseous and lumbricales muscles. The extreme variability of the movements, both on the same side and on the opposite side at various ages, are recorded in tables presented in a manner that does not lend itself to abstracting.

In commenting on the plantar reflex, he states that the general irritability increases for two or three months, then diminishes. The type of reaction also differs, so far as the early movements are slow and of long duration; and particularly in babies born before term, there is a general tendency to approach the intra-uterine attitude. Later these reactions become more rapid and the semipermanent contractions become less frequent.

Myelinization of the peripheral nerves appears in the fetus of from about 4 to 5 months, which corresponds to the onset of quickening. By the eighth month myelinization is almost complete. In the fifth and sixth month of intra-uterine life, myelinization makes its appearance in the anterior columns, later in the lateral columns. By the ninth or tenth month after birth, the pyramidal tracts have been formed.

Held made the interesting observation that the eye of a dog which is exposed to a bright light, while the opposite eye is closed, is myelinated more rapidly. This suggests an explanation for the variability in response to stimulation of the peripheral nerves.

From the work of Soltmann and Westphal, it appears that the sensory and motor nerves are less irritable in early life than in adult life.

Babinski and his followers adhere to the point of view that an extension of the great toe invariably means an anatomic lesion of the nervous system. All writers, however, do not agree with him fully. Attempts have been made to distinguish extension of the great toe from medullary automatism and the defensive reactions. While the various points of view have been ably defended by some and gravely questioned by others, Bersot retains his equanimity by taking side with none of them. He states that variations are to be expected, that the various types of reflexes noted in infants of different stages of development may remain latent and come to light only under certain pathologic conditions.

Woltman, Rochester, Minn.

TREATMENT OF ACUTE POLIOMYELITIS WITH IMMUNE HORSE SERUM. E. C. Rosenow, J. A. M. A. **77**:588 (Aug. 20) 1921.

In a series of experimental investigations, Rosenow found that monkeys were not protected against intracerebral inoculation of the virus of poliomyelitis by intraspinal injections of immune horse serum. But, on the other hand, he found that intravenous injections did confer protection. Of 259 cases in man treated intravenously and intramuscularly, none of the sixty patients treated in the preparalytic stage died, and no residual paralyses were found. Of sixty-one patients with slight paralysis all but one recovered completely. Out of 123 cases eighteen patients died with advanced paralysis, eleven of them having symptoms of medullary involvement; thirty were left with residual paralysis ,and sixty-one recovered completely. Fifteen cases of sporadic poliomyelitis were treated, with one death and six recoveries with residual paralysis. Of the 259 cases, there was a mortality of 7.3 per cent., made up mostly of those cases in which serum was given late (eleven of the nineteen cases). Residual paralysis was present in 21 per cent., omitting the late results which were not known in fourteen cases. Of 197 paralyzed patients, nineteen (9.6 per cent.) died, which gives a mortality of 4 per cent. by eliminating eleven patients whose cases were hopeless at the time of serum treatment. Twenty-one per cent. of 176 paralyzed patients who survived had residual paralyses.

The efficacy of the serum injection was proportionate to the earliness of the injection, and invariably each successive injection further hastened recovery. The author concludes that immune horse serum has a definite curative value and that an early diagnosis is essential. He recommends spinal puncture in all suspicious cases.

Patten, Philadelphia.

THE CIRCULATION OF THE CEREBROSPINAL FLUID. C. von Monakow, Schweiz. Arch. f. Neurol. u. Psychiat. **8**:232-234, 1921.

Monakow, in commenting on Stern's contribution, emphasizes the fact that the work of the latter quite agrees with that undertaken by the author and Kitabayashi on the pathology of the choroid plexus. Doubtless the production of ventricular fluid by the choroid plexus is under control of the hemispheres, judging from the wealth of nonmedulated sympathetic nerve fibers in the plexus. The fluid from the choroid plexus probably enters the ventricular wall through the intercellular ependymal spaces, after which it is readily distributed in all directions along the glia network, nerve fibers and blood vessels, thus delivering substances to structures in a way that could hardly be accomplished by the blood vessels alone. Doubtless the ventricular fluid bathes the parenchyma directly. Waste products of metabolism are then picked up at the periphery of the cortex, leaving by means of the perivascular lymph spaces of His which open directly into the subarachnoid space. Part of it leaves by way of the venous plexus through the sinuses, part through the pacchionian granulations, part accumulates in the larger cisterns, and part finally reaches the lumbar subdural space where it reenters the blood stream.

According to injection experiments of Sicard and others, it appears that insoluble particles are carried off by "Abbauzellen" in the Virchow-Robin spaces from which they enter the meningeal lymph spaces, finally ending in the lymphatics of the neck. There are, accordingly, two outlets from the parenchyma of the brain into the circulation of the blood, one for soluble substances along the path for fluids, the other for suspended and insoluble material largely by means of the cells.

Woltman, Rochester, Minn.

EPIDEMIC HICCUP WITH GENERALIZED MYOCLONIC MOVEMENTS. Ducamp, Carrien, Blonguier de Claret and Tzélépoglon. Bull. de l'Acad. de méd. **86**:249 (Nov. 8) 1921.

A case is reported of a young woman who, in January, 1921, died after a three weeks' febrile illness in which the symptoms were intense hiccup with myoclonus of the legs and abdominal walls not accompanied by disturbances of the ocular musculature either intrinsic or extrinsic or by lethargy. Breathing was gravely disturbed, and this disturbance was the cause of death. Lumbar puncture had shown a normal spinal fluid.

Histologic study showed that at the peduncles, the pial vessels were overcrowded with red cells and presented a marked infiltration of their walls with leukocytes. Toward the center of each peduncle, there was a round cell infiltration and a neurogliar proliferation. The nerve cells showed an incontestable neuronophagia. The locus niger was slightly affected. In the bulbar part of the fourth ventricle the neurogliar proliferation and neuronophagia were more extended than in the peduncles. At the vagal nuclei there was perinuclear chromatolysis and sudan stain demonstrated marked lipoid granulations in the perinuclear region.

Throughout the cervical cord there was congestion together with ependymal round cell infiltration, and in the anterior horns the cells showed widespread chromatolysis.

The authors present their case and give the histologic findings without saying whether in their opinion these findings warrant the inclusion of the case in the epidemic encephalitis group.

Davis, New York.

THE INTERPRETATION OF SEROLOGICAL FINDINGS. STERNE MORSE, State Hosp. Quart. **7**:20 (Nov.) 1921.

In the interpretation of serologic findings which diverge among themselves and remain divergent after repetition one has several possibilities to consider, of which the following are examples:

1. A positive cell count, a negative Wassermann reaction in the spinal fluid, a positive blood Wassermann reaction. In this situation syphilis of the central nervous system is probable unless some other condition, such as epidemic encephalitis or brain tumor, is associated with systemic syphilis.

2. A positive cell count, a faintly positive Wassermann reaction in the spinal fluid (1 or 2 plus in the 0.5 c.c. dilution), and a negative blood Wassermann reaction. Syphilis of the central nervous system is probable.

3. A doubtful cell count (4 to 9 cells), a faintly positive Wassermann reaction in the spinal fluid (1 or 2 plus in the 0.5 c.c. dilution), a strongly positive blood Wassermann reaction. Here also syphilis of the central nervous system is probable.

4. A negative cell count, a positive globulin reaction, a faintly positive Wassermann reaction in the spinal fluid and a positive blood Wassermann reaction. In this group syphilis of the central nervous system may or may not be present, as such findings can apparently occur in systemic syphilis.

POLLOCK, Albany, N. Y.

SPINA BIFIDA. F. C. PYBUS, Lancet **2**:599 (Sept. 17) 1921.

Pybus discusses briefly the following types of spina bifida: spina bifida occulta, meningocele, meningomyelocele, syringomyelocele, and myelocele. Their diagnosis, the congenital malformations accompanying these tumors, the selection of cases for surgical treatment, and the method of operation are also considered.

The author refers to four children in one family who had some degree of spinal defect. The eldest child died at the age of 18 months as a result of spina bifida, type unknown, and hydrocephalus. The second child, aged 10 years, had a spina bifida occulta, indicated by a scar and depression in the upper dorsal region and by slight scoliosis. A roentgenogram showed a defect of the vertebrae in this region. The third child, aged 9 years, had a meningomyelocele in the sacral region. This was treated surgically with excellent results and the patient is now quite well and without deformity, the only residual symptom being an inability to retain urine as long as usual. The only defect in the fourth child is an exaggerated postanal dimple.

POTTER, Mercer, Pa.

NOTE ON THE TECHNIC OF THE TREATMENT OF SYPHILIS. THEODORE D. REED, State Hosp. Quart. **7**:30 (Nov.) 1921.

1. It is desirable in the intravenous administration of neo-arsphenamin, particularly to the insane, who may be disturbed, to administer the drug as rapidly as is compatible with good results.

2. No unfavorable reactions have been noted by us following rapid administrations.

3. No unfavorable reactions, either symptomatically or in the blood, have been noticed after giving neo-arsphenamin in high concentration, that is, 0.9 gm. per 2 or 3 c.c. of double-distilled water.

POLLOCK, Albany, N. Y.

Society Transactions

NEW YORK NEUROLOGICAL SOCIETY

Joint Meeting with the Section of Neurology of the Academy of Medicine, Nov. 1, 1921

Foster Kennedy, M.D., and S. P. Goodhart, M.D., *Presiding Jointly*

A CASE OF FOURTH VENTRICLE TUMOR WITH SURGICAL INTERVENTION. Dr. I. S. Wechsler.

A young housewife, aged 29, was first seen May 25, 1921. She complained that, beginning suddenly in November, 1920, she suffered from dizziness and spells of momentary darkness. The attacks lasted a few seconds; she felt like falling and occasionally did fall, though to no particular side. The dizziness was especially apt to come on when she got up on a chair. To overcome the vertigo she had to hold her head in a rigid position. The spells would disappear for a few weeks. She did not complain of headache, vomiting or tinnitus. She had gained 30 pounds (13.6 kg.) in weight and her menses had become irregular, prolonged and profuse. The gait was normal.

The neurologic findings were practically negative, except for bilateral choked disk of 5 diopters, a somewhat acromegalic face and inequality of pupils. The diagnosis made was tumor of the fourth ventricle—tumor because of the choked disk, and fourth ventricle because of remissions, of the need of holding the head rigid to overcome the vertigo (interpreted as a modified Bruns symptom), and because of the absence of other localizing signs. Tumor of the quadrigeminals was ruled out because of the absence of pupillary signs and of ocular palsies; tumor of the pituitary was also thought unlikely, despite the acromegalic face, gain in weight and menstrual disturbances. Cysticercus was considered.

The patient was admitted to the Mt. Sinai Hospital. The blood Wassermann and urine were negative and the blood chemistry was normal. Eosinophilia of 7 per cent. indicated cysticercus. The roentgen ray showed a normal sella and no signs of pressure. Dr. Elsberg performed a suboccipital craniotomy and found a tumor filling the fourth ventricle. It was adherent to the floor and sides and to the calamus scriptorius. An attempt to remove a piece of the tumor resulted in bleeding, which necessitated a rapid retreat. The tumor appeared to be either a glioma or ependymoma.

Soon she developed some dysarthria, a little staggering, vomiting and slight optic atrophy. At no time did she have nystagmus, pyramidal tract signs, cranial nerve palsies, sensory disturbances, vomiting, headache, rigidity of the neck, polyuria, glycosuria or vagal symptoms. The patient is still living, five months after the operation, and has improved somewhat.

DISCUSSION

Dr. M. Neustaedter: What was the pulse rate?

Dr. S. P. Goodhart: Was it practical to make an effort to remove any part of the growth? It seems remarkable indeed that a tumor of such size should have been within the fourth ventricle and given practically no signs. I presume it is because the tumor is soft in character causing only slight mechanical displacement. It is surprising that a growth so far back should have caused 5 diopters of choked disk and no indication of involvement of adjacent structures.

Dr. B. Onuf: Was one of the symptoms titubation of gait?

Dr. Wechsler: The pulse was always within normal limits and so was the respiration, except during and immediately following the operation. The tumor was soft.

A PRINCIPLE, HITHERTO UNDESCRIBED, OF THE PHYSIOLOGY OF MOVEMENT AND POSTURE. THE PRIMITIVE SPINAL INTEGRATION OF MOVEMENT IN VERTEBRATES. Dr. Walter M. Kraus.

At the present time we describe movements in such terms as extension, abduction, internal rotation, etc. In other words, we are describing activity of a neuromuscular mechanism in terms of the muscular part of that mechanism alone, leaving out the neurologic element of that movement; leaving out mention of its control by the spinal cord and its peripheral nerves. When we describe a complicated movement guided by integrations of the nervous system at levels higher than the spinal cord, we omit consideration of the final neuromuscular mechanism. It would seem wise to add some terms to those describing muscular movements which would give a notion of the embryology of these muscles as well as their innervation. This can be done very simply.

The nervous system is unquestionably built up of a series of physiologic levels, of which the higher or more recent ones, phylogenetically speaking, carry out functions which are different from the lower ones. It is my opinion that we must have some conception of the integrating action of the lowest levels in order to interpret the higher levels. We must know how the spinal cord integrates movements in order to understand how such higher integrations as the cerebellar act; and ultimately to understand why it has become necessary for these higher integrations to appear at all.

Properly to examine integration of movement in the spinal cord, it is necessary to consider in detail the general plan of peripheral nerves, the general plan of the innervation of muscles by them, and the embryologic grouping of muscles. I wish to present only the simplest facts in connection with these structures, introducing no theoretic considerations.

A typical thoracic spinal nerve having nothing to do with the limbs, shows a number of divisions after union of the posterior and anterior spinal roots. The trunk so formed divides into an anterior and posterior division. The anterior division divides further into a lateral and an anterior branch, the lateral branch dividing into a dorsal and a ventral.

As far as the axial musculature is concerned, the portions of it developed from the ventrolateral portions of the embryo are supplied by the anterior division and its branches, while the posteromusculature is supplied by the posterior branches. Thus a simple scheme results from a physiologic point of view, in the notion that general movements of extension are guided by the posterior division, while flexion and lateral movements are guided by the anterior division. When we apply this to the limb plexuses, we find ourselves confronted by two theories. Before stating them, it is necessary to emphasize that the limb plexuses do not include any part of the posterior division. One theory assumes that the plexuses are made up of the entire anterior division, the other that they are made up entirely of the lateral branch of this division. For the purposes of this discussion it does not seem at the moment very important to try to reach a decision as to which of these theories is correct. I shall assume that the plexus is made up solely of the lateral branch, proceeding to discuss the details of my problem in these terms.

The primitive extremities of the embryo are flattened buds having a dorsal and ventral surface. The premuscle mass on the dorsal side gives rise to muscles the majority of which, in the adult, have an extensor function. The premuscle mass on the ventral side gives rise to muscles the majority of which have a ventral function. The crux of the whole situation lies in the fact that when considering the simplest function of a muscle, we find certain muscles have a function opposite to that which would be expected from a knowledge of the side of the limb bud (ventral or dorsal) from which they develop; for example, the iliopsoas group develops from the dorsal muscle mass of the lower limb bud but has a ventral function, that is flexion.

To return now to the question of innervation: We find that the embryology of the muscles is beautifully emphasized by the innervation of these muscles. It is well known that the nerves of the brachial and lumbosacral plexuses divide into two definite groups; one of which is posterior or dorsal and the other anterior or ventral. In the arm the ventral branches of the brachial plexus innervate the subclavius and pectoral muscles as well as all the muscles supplied by the musculocutaneous and ulnar nerve. What we find when we make a detailed table of muscles based on (1) whether they have been derived from the dorsal or ventral aspects of the limb bud, and (2) whether they are supplied by dorsal or ventral branches of the limb plexuses, is that those muscles which develop from the dorsal layers of the bud are supplied by the dorsal branches of the limb plexus. The analogy to the condition in the axial musculature is obvious.

From all this we arrive at some possibility of schematization. In the nerves and muscles of the upper limb we find, as in the case of the iliopsoas mentioned before, that a muscle which would be expected to have an extensor action has in reality a flexor action. In other words, were we to group the muscles acting in any given movement merely on the basis of their activity as muscles and leave out of consideration their embryology and activating nerves, we would be leaving out entirely the division of these nerves and of their end organs, the muscles, into a large ventral and a dorsal group.

To illustrate how this information may be used for discovering just how the spinal cord may integrate movement, let us take the process of stepping. The extreme forward movements of the leg are carried out by the iliopsoas, quadriceps and tibialis anticus muscles. Though this forward movement of the leg as a whole is spoken of as flexion, it is quite obvious that it is dorsal action since all the muscles which carry it out are of dorsal origin. On the other hand, the carrying backward of the leg is brought about by the hamstrings, gastrocnemius and soleus group and the tibialis posticus, all muscles having a ventral innervation and being of ventral embryologic origin. Consequently the movement of extension of the leg as a whole at the hip is, in reality, ventral in origin. To go further and take the associated movements of the arms and legs, when the left arm is forward and flexed, the left leg is extended at the hip, flexed at the knee and extended at the ankle. It is generally stated that the arm and leg on the same side are acting oppositely, in that the arm is flexed while the leg is extended, and the arm is, for example, forward while the leg is backward. If we interpret this position in terms of the neuromuscular mechanism controlling it, rather than in terms indicating the geometrical relations, such as flexion, extension, etc., we find that the arm and leg on the same side are both directed, in this particular example, by ventrally innervated muscles, so that the notion that the arm and leg go in opposite directions on the same side must be reserved when the neuromuscular mechanism is considered as the basis of movement.

It is proposed that to the words now used to indicate the activity of a muscle such as flexion, abduction, extension, etc., one of two words be added, namely: ventrad or dorsad, which would serve to indicate three things:

1. The embryologic origin of the muscle.
2. The nerve supply of the muscle (ventral or dorsal branches).
3. The primitive direction in which the limb was carried by that muscle.

By adding these terms we describe movement in terms of the neuromuscular mechanism.

Furthermore, the primitive integration of movements of the spinal cord is seen to be one which throws into activity the muscles which develop together and are innervated together. This simple movement of a group of such muscles must be brought about by a correlation mechanism within the spinal cord, and forms the foundation of movement. So simple a movement as could be brought about by the simple activation of large groups of what were primitively ventral or dorsal muscles, was obviously insufficient for the needs of animals. Further and different integrations of movement became necessary and so not only the spinal cord but the more recently developed portions of the nervous system came into existence in order to make possible these new and more complicated patterns of associated movement. An example of one of these within the spinal cord itself is the flexion reflex, "flexion of the three great joints." This term gives the impression of a certain homogeneousness of action which, when interpreted in terms of the neuromuscular mechanism, is found to be entirely absent, in that flexion of the hip is a dorsad movement carried out by the iliopsoas group, flexion of the knee is a ventrad movement carried out, in this instance, by the hamstrings, and flexion of the ankle is a dorsad movement carried out by the tibialis anticus.

DISCUSSION

Dr. S. E. Jelliffe: I feel quite certain that Dr. Kraus has emphasized a method, or a new method, of analysis of motion, and whereas for myself the embryologic argument always lags behind the phylogenetic, I should like very much to have him link up the phylogeny of these movements and show wherein they conform to the present embryologic schemes. Then I think a certain number of the difficulties that he himself has suggested will perhaps be clarified. His presentation is most stimulating.

Dr. Kraus: I think the phylogeny of the matter is the only ultimate way to decide it. The reason for bringing these little animals down was to emphasize that point. I do not think, however, that we need to give the "why" of these things to emphasize the facts. The facts remain and I am dealing with facts, not theories.

Dr. Stookey's emphasis of the many functions of a single muscle is extremely pertinent. (Dr. Stookey's discussion was withdrawn.) We must take a primary function first and then try to explain if we can (and in many instances we can) why a muscle assumes a secondary function. Take, for example, the activity of the flexors of the wrist. There the prime action is flexion; but they have also assumed an action of adduction or abduction. We must examine these movements carefully before reaching conclusions.

Now, as to abduction, let us take the abductor of the thumb—that certainly is abduction; it is from the middle line, the axis of the extremity. But as I am speaking of terminology, I should like to emphasize that when we speak of it as abduction, we think of it in the same way as we think of abduction of the arm, though the innervation and embryology indicate that one is dorsad while the other is ventrad. If we use the terms ventrad and dorsad we know how different is the innervation in these two cases. I do insist (and I will make this the only point I would like to insist entirely on) that we must use the neuromuscular mechanism as a basis for the interpretation of movement and not the muscular only. If we are going to interpret the activity of higher levels, we must interpret that through the nervous system. We must not pass from the action of the cortex to flexion, for example, without knowing in the least how the spinal cord has come into that integrating action.

SOME THERAPEUTIC EXPERIENCES OF MYASTHENIA GRAVIS.

Dr. Charles L. Dana.

The prognosis of this disease as generally given is very bad; according to Oppenheim, twenty-six of thirty-eight patients died; Dr. Hun found that most patients die in from one to three years; Dr. M. Allen Starr found that about 45 per cent. of the cases collected by him died within six months. My experience had been quite different.

I have had under observation fourteen cases during the last twenty years. I have not been able to follow up all of them, and some have died from natural causes but none of them has died of the disease while under my observation, and I have watched them for from one to seventeen years.

Duration of Disease While Under Observation

1 year	5	7 years	1
2 years	1	12 years	1
4 years	1	13 years	1
5 years	1	17 years	1
6 years	1		

Results

Recovered	4	Died of cancer	1
Practically well	3	Not followed up	1
Improved	4		—
Not improved	1		14

I think that the better prognosis of the cases was due, in part at least, to the treatment. This consisted of massive doses of strychnin combined with rest and elimination. The doses reached in some cases ⅓ grain given hypodermically two or three times a day.

In 5 per cent. of my cases the serious attacks were preceded by short attacks lasting only a few weeks and characterized by some ocular symptoms and bulbar weakness. In some cases, these prodromal attacks were not followed by any other attack for many years; in one case as long as seventeen years elapsed. I think it quite probable that mild abortive attacks characterized by diplopia and slight exhaustion of the bulbar centers are not infrequent. In some cases, the prodromal seizure was simply an ocular one, and one of the causes of casual ocular palsies of permanent type undoubtedly is myasthenia gravis. This is not recognized in the systematic works on ophthalmology. Myotonia is an occasional complicating symptom of myasthenia. I think the disease is toxic and endogenous and one that affects both motor neuron and muscle. I have seen no result of note from endocrine therapy.

DISCUSSION

Dr. Bernard Sachs: I am willing to endorse Dr. Dana's rational therapy. In the cases we have had at the hospital during the past ten years, the uniform treatment, particularly for the bulbar symptoms, has been the use of strychnin, but we have not employed it in any such doses as Dr. Dana now recommends. I shall be very glad to try the high dosage.

Dr. Dana's experience has been extremely fortunate. Of all the cases in which I have made the diagnosis of myasthenia gravis pseudoparalytica, only a few patients recovered or remained alive long enough for me to record a temporary recovery.

I wonder whether Dr. Dana has not had the same experience that I have had in the course of these years: first, that the disease that some of us style myasthenia gravis includes a number of rather discordant types of disease, particularly in view of our experience during the past few years with various forms of encephalitis, not only epidemic encephalitis. There are no doubt other forms of infectious encephalitis besides epidemic encephalitis, and I am inclined to think that some of these cases covered by Dr. Dana may have been cases of that type and not cases of myasthenia gravis. The entire subject still remains more or less of a mystery to me, except that I have no doubt that there are cases that are due to severe toxic products circulating in the body. It would be only a short step from that to the supposition that some of the cases were due to infections of all sorts in the body, and I believe that further study probably will prove that many of these cases are really distinct forms of encephalitis.

If I were to state a general impression as to the number of cases I would be willing to call myasthenia gravis, I should say that I had not seen more than six or ten of them in so many years.

Will Dr. Dana state whether the symptoms cleared up rather promptly on the large doses of strychnin?

Dr. L. P. Clark: A number of years ago I was particularly impressed with the enormous advantage that Gowers gained from the use of strychnin in myasthenia gravis. Later, I noted cases in the service of Dr. Starr but recall no advantage obtained with either small or large doses. I continued to use strychnin for two or three years, beginning with small doses and running up to ¼ grain. How does Dr. Dana explain the action of the strychnin, if this is some form of glandular disturbance? How does the strychnin operate against an organic conductivity of the systemic values?

I have been very much surprised to note the enormous suggestibility that these patients have. Several months ago I was asked to see a patient because there was possibly a neurosis superadded. The diagnosis seemed quite correct and everything had been done for the patient that was possible. I suggested a change of environment by taking a rest in the country, and was much surprised the other day when this man's wife reported that he was walking two miles, was engaging in all sorts of activities, and everything but his speech (which was predominantly bulbar in type) was enormously improved. I was particularly impressed that this patient was going through a rather definite, almost psychotic delirium and I was surprised to see the type of mental reactions he was taking.

Dr. Smith Ely Jelliffe: While listening to Dr. Dana's paper, my thoughts have run along the lines that Dr. Sachs has so well emphasized: That whereas one can predicate a pure type of reaction focused about what is termed "myasthenia gravis," shading off from such a picture a great number of semi, demi types are observable, some of which undoubtedly belong with the groups which Dr. Sachs has emphasized. There are also others that heretofore have been called periodical palsies, and a whole group of phenomena related to irregular muscular reactions due to acute or chronic conditions chiefly located in the medullary nuclei. It seems to me that that is a useful way of looking at the whole situation. Of course, if, with a certain trend of mind, one is apt to lump all these things together and speak of a disease *sui generis,* then I think Dr. Dana's attitude of mind quite justified. However, if one is inclined to see so-called pure types and divergent types and a whole group of situations which clinically may be grouped about a definite syndrome, it seems to me the results which have been reported are quite comprehensible.

Dr. Dana has spoken of the endocrine situation. It seems to me that Dr. Dana sketched too broad and glaring a type of generalization. I feel disposed to think that if the particular group of glandular involvements had a certain specific action, either on one or the other branch of the vegetative nervous system, then one could commence to formulate endocrine disorder. That is, one might say, "Here is a disturbance of one or another nervous arc in a muscular mechanism which is doubly innervated." The sympathetic arc of the vegetative mechanism apparently is the one that is most primarily involved in the *pure* types of myasthenia gravis. If that be so, there is a good rationale why strychnin should be of value in that type, because it is, of all of the plant alkaloids, the most powerful stimulant to the sympathetic branch of the vegetative nervous system. That is also a reason why calcium is therapeutically of value, and why sometimes this type of myasthenia gravis cases appears closely correlated with parathyroid disturbance.

Dr. B. Rosenbluth: In studying the literature of myasthenia gravis I came across a similar disease occurring in Switzerland and also in Japan, which offered all the symptomatology of myasthenia gravis. This disease occurs in the most crowded quarters and among the poorest class of people who are undernourished. In Japan it is found among the laborers in the rice fields.

I have had only four cases of myasthenia gravis, and instead of using medication, I have put the patient to bed and fed him by means of the duodenal tube. Dr. Larkin took cultures from one of my cases and one other but was unable to discover anything definite. Two of my patients recovered. We can see that any form of treatment that is kept up long enough, with stimulation and nourishment, will bring the patient over the bad part of it for two or three years.

Dr. Dana: Does this disease keep on recurring every year?

Dr. Rosenbluth: It recurs every two, three or four years.

Dr. Charles E. Atwood: The disease renews itself frequently by fatigue. Possibly the recurrences are from the suboxidation which takes place in fatigue. I have a case now that has lasted since 1907. The patient has done best on hygienic symptomatic treatment and small doses of strychnia. The myasthenic reaction is one of the most reliable tests, perhaps, in differentiating myasthenia gravis from other diseases.

Dr. Foster Kennedy: My experience has been that there is rather a difference of prognosis in the subjects who are young; that is, in the subjects who are under and those over 40, it being decidedly worse in those who are in their twenties. The disease, as I have seen it, has run a very much shorter course in the young than in the middle-aged or aged.

I have seen a series of necropsies on myasthenia gravis, with the extraordinary chance that in five of them an enormously enlarged thymus existed. This thymus was not so great as regards glandular bulk, but it was great as regards glandular expansion. The thymus was perhaps two-thirds the size of my hand, stretching down over the pericardium—an extraordinary phenomenon, one which certainly cannot be without significance in the disease, though its exact correlation with the symptoms I am not able to state.

Dr. Charles L. Dana: With regard to the point that Dr. Sachs made, I had written this—I did not read it: "Myasthenia gravis is a disease which runs peculiarly true to type," etc. Therefore, I think that Dr. Sachs' suggestion that we ought to scrutinize these cases with especial care is a wise one. One case I had in mind was perhaps not true myasthenia gravis, though I thought it was at the time. We do not have to give massive doses of strychnin always or all the time. I find sometimes that 1/15 grain is enough, and sometimes even a little less; but it seems to me that the most permanent and satisfactory results were those in which these larger doses were given for a considerable time.

The symptoms do not clear up immediately. You will have to use the injections for perhaps three or four weeks before they begin to show results. It seems to me that there is nothing physic in the patients. The patients were treated seriously, of course; they were put to bed a large part of the time and they were kept very quiet; they were given these large doses and they knew they were being actually treated. There was not any suggestion about it, nor were there any psychic elements in the case.

I do not quite understand Dr. Jelliffe's remarks. It seems to me the disease is a poison of the somatic rather than of the sympathetic part of the system.

Dr. Jelliffe: But the somatic muscles have a double innervation.

Dr. Dana: But it is the somatic part of the innervation that is affected. Mr. President, in regard to the point that you made, I can only say that one of my patients, one of the very best ones, a boy of 19, has now been well for six years; but all the other patients were in the thirties or forties—perhaps more of them beyond 40 than under it.

The Three Hundred and Ninety-Second Regular Meeting, Dec. 6, 1921

Dr. Foster Kennedy, *in the Chair*

SYNDROME OF THE RETROPAROTID SPACE, WITH SPECIAL REFERENCE TO A NEW INTERPRETATION OF SOME FORMS OF FACIAL PARALYSIS. Dr. Byron Stookey.

Dr. Stookey presented a patient showing a pure syndrome of the retroparotid space, as described by Villaret (1916). Though the injury had been suffered sixteen years previously, complete paralysis of the glossopharyngeal, vagus, spinal accessory, hypoglossal and cervical sympathetic nerves still remained, with ptosis of the eyelid on the same side, miosis, narrowing of the palpebral fissure, enophthalmos, loss of taste on the dorsal third of the tongue, difficulty in swallowing and eating, paralysis and atrophy of the tongue, and weakness in elevation of the arm due to paralysis of the trapezius. Attention was called to the development of the clavicular portion of the pectoralis major and the clavicular head of the deltoid, both of which stood out prominently on elevation of the arm beyond 115 degrees. These two muscles thus compensated for the loss of rotation of the scapula in elevation of the arm.

Oblique withdrawal of the dorsal wall of the pharynx toward the sound side—"mouvement de rideau" of Vernet—was demonstrated; but Dr. Stookey did not believe that in this patient this sign could be taken as a sign of glossopharyngeal paralysis in view of the other nerves involved. Vernet's view that the vagus is a purely sensory nerve was denied, in view of the histologic character of the dorsal motor nucleus of the vagus and the nucleus ambiguus as shown by finer histologic studies of the nuclei of the vagus following section of the vagus. Its efferent character, as well as afferent, was emphasized. In Dr. Stookey's patient a slight facial weakness when the face was at rest was noted, though the facial nerve was intact and there was no weakness in voluntary movements. There seemed to be rather a loss of tone. In view of the fact that striate musculature possesses a dual efferent innervation, this loss of tone, it was believed, might be due to loss of the efferent sympathetic fibers to the facial musculature, because of injury to the superior cervical sympathetic ganglion.

DISCUSSION

Dr. Smith Ely Jelliffe said that he was delighted to hear Dr. Stookey raise the point of the sympathetic innervation of the musculature in the myasthenic reaction. He believed that Dr. Stookey had been a little overcareful in advancing his hypothesis of double innervation, and that he had stuck too closely to the anatomic evidence alone. It seemed that the splanchnic remnants were over-represented in the facial group.

Dr. I. Abramson believed that the dual innervation might account for the frequency of contractures after facial palsy. This occurs more often than with any other cranial nerves. While explanations of contractures have been many and varied, none of them seems fully to account for the phenomena. A second corollary is the occurrence of the facial hypotonia, seen in tabes, causing sagging of the features. It is known that the cervical sympathetic nerve is often attacked in tabes. Facial contracture can be regarded as a tonic spasm on account of the loss of normal equilibrium between the clonic and the tonic parts of the musculature.

Dr. Jelliffe added that he referred to Winkler's explanation of the sphenopalatine as a new nerve, and that that probably had considerable relevance to the discussion of this region. He noticed in the case presented that the tongue was very red and rigid. The salivary innervation was also involved.

Dr. Foster Kennedy said he was surprised that Dr. Stookey laid such emphasis on the comparatively recent recognition of the syndrome as an entity. It surely preceded the date that Dr. Stookey gave. He asked whether this condition was not diagnosed by many of the members as early as 1915. He said he recalled a case in the Neurological Institute, in 1910, in which syphilitic involvement of the skull gave evidence of a lesion clearly recognizable as that described by Dr. Stookey. In the war, too, cases were noted with frequency. The sign of glossopharyngeal paralysis by deviation of the uvula had been recognized since 1907. He referred Dr. Stookey to a paper by Maloney and Kennedy, in *Brain,* 1912, on the pressure sense in the face.

Dr. Byron Stookey (closing) said he could add nothing to the evidence in regard to the sphenopalatine. It was supposed that the supply of the parotid through the ninth nerve was from the *nucleus salivarius* to the otic ganglion and thence by the auriculotemporal nerve. The preganglionic fibers were from the ninth nerve, and the postganglionic fibers from the otic ganglion through the auriculotemporal to the parotid.

In answer to Dr. Kennedy, he said that there was no reference earlier than Villaret, in 1916, to the retroparotid space as a locus of extracranial injury of those nerves. The syndrome of Hughlings-Jackson is not extracranial. Tapia and Schmidt refer to lesions involving the nucleus ambiguus, but these are intracranial, not extracranial injuries. He asked whether Dr. Kennedy's case involved the cervical sympathetic nerve. Dr. Kennedy had referred to deviation of the uvula, but this was, of course, totally different from deviation of the posterior wall of the pharynx due to paralysis of the superior constrictor muscle. In paralysis of this muscle, the pharynx is drawn obliquely over to the sound side—*"mouvement de rideau."* He asked whether Dr. Kennedy's own work did not deal exclusively with the afferent innervation of the face, and not with the efferent. If Dr. Kennedy's work referred to a dual innervation, it antedated all other work in this line by quite a few years.

Dr. Kennedy said that his work did not conclusively show this point.

Dr. Stookey said he was pleased to know that Dr. Kennedy's work dealt solely wth the afferent side, as he wished to emphasize that his paper that evening referred to a dual efferent innervation, not afferent.

A PSYCHIATRIC STUDY OF SUICIDE. Dr. Thomas W. Salmon.

Dr. Salmon presented the human, rather than the professional, side of the problem. It has been stated that there are few people who at some time or other in their lives have not thought of self-destruction; but it is not easy to see exactly what is meant by that statement. It is true that most people, in childhood, have had visions of being laid out in the best chamber, surrounded by weeping relatives and members of the family who are overcome with grief at their former lack of appreciation of the departed. Thoughts of suidside are almost equally wide spread, and most people who have left autobiographies have spoken very definitely of suicide; but these thoughts are usually disposed of by the mechanism, which we possess, to dispose of ideas which interfere with our happiness. The relative infrequency of suicide accomplished, as compared with thoughts of self-destruction, bears witness to our power of preventing this type of casualty.

Apart from the human standpoint, suicide is of interest as a psychiatric study: first, because it is due to a preventable phase of mental disorder; and, second, because it involves questions of therapeutics and of hospital management. Recently, suicide has taken on a new and wider interest, and it is from this larger standpoint of methods rather than material that the present study was undertaken. Not only were cases considered which were allied to frank mental disorder, but also those in which this strange disturbance of human conduct occurred in sane persons.

Dr. Salmon took as an associate in this study a well-trained social worker, and tried to follow up every case. A period of six months was taken for intensive study which presented many difficulties, because it was not always possible to precede the undertaker or to follow the police, or to make oneself welcome in every home; but every available channel of evidence was used.

The successful collection of minute details was due to splendid cooperation on the part of medical examiners. It was found that the gas companies were those next interested, whether on account of the amount of gas wasted, or not, is not clear.

Generally speaking, it would seem to be a simple matter to determine whether or not suicide took place; but those who have studied the subject tell us that probably not more than two thirds of the cases of suicide are reported, and that many cases are mistakenly termed suicide; also many cases are associated with homicide, so that a double toll of lives has to be estimated. Any personal stress or economic stress may be associated with suicide; but no one knows the exact proportion of these cases.

Sentiment which interferes with these investigations may be of two kinds: In some cases, the relatives want the suicide made widely known; this usually has to do with various religious procedures which are modified in case of suicide. On the other hand, every effort is made to assign the death to natural causes instead of to suicide. For this reason, one sometimes gets better evidence from neighbors than from relatives. Dr. Stearns found a typical illustration of this in one case of a very old man who committed suicide. The relatives were reticent about giving information; but a carpenter, who lived next door, told the physician that he knew the old man would commit suicide because he sat for hours in the carpenter's yard without speaking and when he spoke it was to complain that his bowels ended in the middle and that a man in that condition ought to be dead. The family physician confirmed this evidence.

Suicide from suggestion is not uncommon. One very old man traveled all the way from Chicago to hang himself in a certain barn, because it was the custom for members of his family to do so, and he wanted to commit suicide in the orthodox way. The obvious cure in a case of this kind would be to burn down the barn and prevent further incidents. In New Orleans, there is a "suicide oak" which no doubt has helped, with the aid of suggestibility, to put many persons out of the world.

The statistical study of suicide shows that it is steadily on the increase in all American cities. Many theories have been advanced, but the one most tenable is the steady drift of the population to the cities. Why suicide should be more common in cities needs careful analysis. Perhaps availability of weapons has something to do with it, as has also the ready supply of gas. Dr. Stearns found a very striking relation between depression and suicide; he found also that the suicide rate rises with every decade of life in a uniform manner. In the eighth and ninth decades, it is remarkably high. He found a high rate among the Irish, in contrast to the low rate found by other workers. Among the foreign born the rate is higher. This reflects the greater economic stress in this section of the community.

Factors of medical interest are the relation of suicide and mental disease: In 42 per cent. of the cases there is a history of mental disorder, and if we include psychoneurotic cases this rises as high as 58 per cent. Seventy per cent. of all cases of suicide in which there is mental disorder occur in the manic-depressive groups; in 23 per cent. there are other psychoses, making a total of 93 per cent. of mental disorders in which depression is a marked factor. Contrary to the usual idea, there are often depressive cases and suicides among psychoneurotics. If it were not for the fact that most patients with mental disturbances are hospitalized and guarded, the number of suicides in this group would be alarming. In a group of this kind, 157 in number, which was studied, seven were among children. Child suicide has been made a study by itself; but Dr. Stearns secured full data in these cases, and it was surprising what abnormality existed long before suicide occurred.

This wealth of descriptive material points to definite measures of prevention. The suicide death rate is higher than that for typhoid fever. We spend large appropriations for the prevention of typhoid, but we do nothing to prevent suicide. The very first preventive measure of importance that occurs to one is the necessity of recognizing depressions in their earliest stages. This is a responsibility for the public and for the medical profession. A distinguished surgeon in Chicago told Dr. Salmon that a minister of his acquaintance was fond of coming into his office, and wasting the physician's time by telling him how worthless he felt himself to be, and what a discredit to his profession. The surgeon said to him, "If I felt like that, I would go to the lake and walk east till my hat floated." Finally, this is exactly what the minister did. The suggestion was the final link between depression and suicide. The danger is greatest in the early and the late stages of manic depression. In the severe stages the mind does not focus clearly on the suicidal idea.

In one case recalled, that of a magazine writer, the man came into Dr. Salmon's office and introduced the topic of what became of unclaimed bodies found in the East River. He said he had a professional interest in the problem. The man had a pallid, unhealthy appearance, and it was suspected that he was suffering from depression. Dr. Salmon told him that the bodies were distributed to the various dissecting rooms for the use of medical students. Feeling that confession might pave the way to relief, he went on to speak frankly of the subject of suicide in general and to sketch an outline of the questioner's probable mental symptoms. This produced a response on the questioner's part and he admitted that he was suffering from acute mental depression. He was told that his symptoms were extremely susceptible to treatment and was urged to go to a hospital to be taken care of. Arrangements were at once made for his reception at Bloomingdale and he entered the hospital that evening. He expressed himself as well satisfied, and stated that he felt very much safer when he saw the nurse patrolling the corridors at night and he was able to rest comfortably. Unfortunately, his brother came from Chicago and was very indignant that the patient had been placed in an institution by a "fool doctor." He removed his brother with the idea of taking him home. It was stated that on the journey home the patient appeared unusually light-hearted and facetious. The brother was positive that the patient was much better. On arrival, the patient made an excuse to go to the bathroom for a few minutes and when there cut his throat. This case illustrates the absolute necessity for care in the early depressive stages, and indicates clearly the need for early treatment.

During the war, statistics showed that war must have been in some measure a substitute for suicide. The A. E. F. figures were 5 per 100,000, in contrast to the regular army figures of 53 per 100,000. This large difference probably needs many causes to explain it. One factor may be the exclusion of those persons that are obviously suffering from mental disorders. Hospitals were available from the front line to the base for early mental symptoms, and the slightest abnormality was reported early. Probably the treatment was better in the Argonne than in New York City today.

We have very powerful resources for the prevention of suicide. Many patients who attempt suicide give positive evidence of a long period of conflict before the act—between the desire to die and the instinct to live. The Reverend Dr. Warren has instituted what he calls the "Save-a-Life League." He answers telephone calls from people about to commit suicide. He has some one on hand, day and night, and by entering the field from a different angle, that of religious and moral counsel, he saves people at a critical time. He has a wonderful collection of letters and histories testifying to the results obtained. Probably the most powerful aid is the factor of human friendliness, which is so often lacking in our medical treatment of these patients. One is impressed by the extreme loneliness and isolation of the sufferers seen at Bellevue Hospital after being rescued from attempted suicide. A powerful human resource has not been put into use. In Japan there exists an anti-suicide league, and on the railway crossings there are signs suggesting that these should not be used for suicidal purposes. Whether the suggestion works in the direct or the reverse fashion is doubtful.

The suicidal intent often lasts for years and years before consummation. In Wisconsin, in an insane asylum, a man built an extraordinary barn, with fantastic cupolas. He kept adding one after another, and when he was unable to add another, he hanged himself on the last one. The constructive work had probably been a sort of safeguard, and when this was exhausted, he took his life. Had the architectural standards of Wisconsin allowed of an indefinite number of cupolas, he might have lived to old age. In another case the safeguard proved to be an altruistic reason. An insane man, while walking with a new attendant, tried to jump into the river. The attendant cried out anxiously, "Don't do that or I shall lose my job." This plea deterred the suicide at the moment of impulse.

In regard to other preventive measures, Dr. Stearns suggests that something might be done to lessen the extreme suggestibility of those intending to commit suicide. While the world cannot be adjusted to the psychopathic mind one can place some restrictions as to suggestion on the movies and the drama. Fire-arms and gas can be safeguarded. The fact that there is a diminution of suicide by drowning in winter, on account of the freezing water, shows that availability has something to do with it. The policy of avoiding frank discussion with the patient seems to be a poor one. Often confession proves helpful. The details of general statistics tell little, and the method for future study is the carefully worked out case method from histories of patients who have been rescued. The time for prevention is during the early and late stages of depression when there is a conflict between the desire for life and the choice of death.

DISCUSSION

Dr. Smith Ely Jelliffe said that the subject was so large that many points have, necessarily, to be left untouched. The metaphor of the barn, used by Dr. Salmon, could be taken as an illustration of a type of reconstruction process which takes place in the minds of many neurotic patients. The construction of psychologic barns can be seen as a protective mechanism. If this fact is not recognized, the patient may, in the end, get beyond protective mechanism. Another important point is the recognition of the fact that what may appear as a psychoneurosis on the surface may be the early stage of a severe mental disturbance. The psychiatrist must endeavor to change the mode of expression of the patient into something beneficial. Delusions represent ego-protective devices, and they may be piled up more and more, one above the other. At times these delusional formations of pronounced grade may be replaced by religion, mysticism, or other expression of a less *outré* type. The early and late stages in manic-depressive patients are particularly dangerous. In the early stages they are suicidal, not having built up their delusional defense mechanisms; in the later stages, the patient has come through a rich delusional stage and has to be protected until he gets back to his normal. In regard to methods, the analytic method is often much condemned because so frequently misunderstood; but it may be helpful at a certain stage and more often saves the patient from the river than it drives him to it, as some superficial and nonpsychiatrically trained physicians often claim. To frighten patients away from a competent psychiatrist is as criminal as it is to allow nontechnically trained people to treat mental illnesses.

Dr. S. R. Leahy remarked that while dementia praecox is not usually thought to be associated with suicide, this is not an infrequent combination. When we consider the type of hallucinations it is surprising that more suicides do not occur. The patient may endeavor by suicide to escape the imagined dangers threatening him. The dementia praecox patients that commit suicide are impulsive in type. They do not speak of the intention and evade the issue. If once prevented, they become more determined to commit suicide. In persons with marked mental and motor retardation, suicide is unlikely. They cannot plan self-destruction. The fact that families do not want to put depressed patients in hospitals often leads to suicidal attempts. They are not properly guarded. Patients with alcoholic hallucinations are liable to commit suicide on impulse, to escape their terrors. They are likely to jump off ferry boats or perform similar acts. Any condition, organic or functional, producing depression, makes suicide likely. This is seen in arteriosclerotic or general paresis.

Major Jarvis (by invitation) said that the profuse advertising of every suicide case, with its appeal to suggestion, is to be deplored. Considering that environment in rural districts was a factor, Bismarck drew settlers from remote districts for his rural communities because of the large percentage of suicide. Environment is an important factor, as evidenced by the frequency of suicide at a post in Northern Arizona, called, in the army, "Suicide Post." Four officers attempted suicide there, and even one Indian, the latter being a very unusual occurrence. This post is 110 miles from a railroad and is situated near a dark canyon at the foot of a high lava mountain which shuts out the sunlight at 4 p. m. This gloomy environment is doubtless a contributory factor. Bluntness is sometimes helpful to dissuade from suicide. This is illustrated by the story of a rough and ready old army colonel in whose command a suicide epidemic appeared. He called for one man suspected of contemplated suicide and roughly told him that if he wanted to shoot himself he should go out on the lot and do it instead of messing up the barrack room floor. The result was that the man decided not to commit suicide.

Dr. L. Pierce Clark believed that the personal morale and sense of identity, in the country, constitute a factor against suicide, as compared with looseness of standards in the city. He had been impressed with a peculiar psychology in some patients with depressive conditions. They seem to have a sense of separation from God, by reason of sin, and plan suicide with expiational intent. If they are rescued, and if the intent was sincere, they feel that they have done, as it were, all they can, and have thereby atoned. Thereafter they get well. If they do not make a sincere attempt, they still feel they have to go through the ordeal, and they do not improve. Might this not suggest the advisability of letting these persons really attempt suicide, taking precautions to rescue them, so that they can gain this sense of rehabilitation which helps in their cure? This should be carefully studied. Many patients at Bellevue confess that no one is left who really loves them. This means that the out-stream of the libido has lost its attachments and has resulted in attempted suicide, an extreme gesture of despair.

Dr. Kempf was inclined to take issue with Dr. Salmon regarding methods. He believed that often the part of the body is attacked which is associated with some pain or discomfort, as, for instance, in the case of a man who complained of intense headache and who shot himself through the head; and one young woman who suffered precordial pain who shot herself through the heart.

Dr. Wechsler said that in some cases, such as the hebephrenic types, the impulse has no logical basis.

Dr. Foster Kennedy said that in the war men who wanted to commit suicide often put themselves in murderous positions in the front line. In Europe the method by drowning seems more popular than other methods, and has no seasonal variation. From a study of the suicide rate in Saxony, compared with that of Ireland (358 against 17 per 100,000), it would seem that there must be something more than personal individual variation to account for such racial discrepancy.

Dr. Salmon (closing) said that the increase of suicide had no doubt something to do with the choice of methods. There is avoidance of mutilation by women and the preference for fire-arms by men. In the army shooting is often chosen because it is considered more or less a soldier's death and somewhat removes the stigma. In regard to the story of the blunt colonel, doubtless the frankness was useful in preventing the issue. In regard to the A. E. F., it must be remembered that only 60 per cent. of the men were actually under fire. Some general cause must have operated to lower the suicide rate, since after the armistice it resumed the former proportion. In regard to loneliness in the country, that cannot be compared to loneliness in a large city. There are at present 75,000 ex-service men in New York whose homes are distant. That must have some effect in increasing city loneliness. Nonmental cases are of peculiar interest. The subject is very large and it is impossible to touch more than the outline. The best method of study is the careful detailed case study of the patient who has been rescued from attempted suicide. There rarely is a second attempt. Something has occurred in the life of the patient along the line suggested by Dr. Clark. Often the person who has attempted suicide finds his first friends in the hospital. He is clapped on the back and the friendly democratic atmosphere increases the homely human resources of the hospital and adds to its therapeutics. The days of statistical study alone and of the measurements of skulls and ears are past. When we carry out careful detailed study of living cases as a routine measure we shall know more about the psychology of suicide.

IODIDS, OBSERVATIONS ON THEIR USE AND VALUE, INTRAVENOUSLY. Dr. Frederick J. Farnell.

Dr. Farnell asked whether tissue and cell changes could be more rapidly brought about by giving a highly concentrated solution of sodium iodid directly into the blood stream; whether the same result could be obtained by giving a concentrated solution along with a bland syrup, by mouth, and whether the apparently good results depend on the high concentration or on the intravenous channel of administration.

Iodin in the form of an iodid can be given in hypertonic form intravenously. When given into the blood stream in hypertonic form iodin has a tendency to reduce the idiosyncrasy toward iodism. Iodids introduced into the blood stream appear to readjust systemic fungus disturbances (oidiomycosis) very rapidly. Iodids given intravenously in concentrated form appear to help materially the action of arsphenamin on the diseased tissue and cell. Iodids introduced into the blood stream in hypertonic solutions probably have some influence in reducing the edema, hyperemia, etc., of the brain in increased brain bulk-disorders.

DISCUSSION

Dr. Smith Ely Jelliffe remarked that in recent years he had noted definite restoration of the subject of pharmacology and therapeutics to a place of respect in teaching and a renewal of interest in the action of drugs on the human body. Pessimism is receding and a more healthy pharmacology advancing. The rôle played by iodin in the body is extremely important. The iodin mechanisms are extremely intricate and only partly analyzed, the chief question being the iodin content of the thyroid. He said he had hoped that Dr. Farnell would touch on the action of iodin on the sympathetic arc of the vegetative nervous system. The vegetative nervous system is definitely affected by iodin, chiefly on the sympathetic side. This, in turn, influences body metabolism. Dr. Farnell had approached the subject from a different angle—that of specific disorders.

Dr. J. H. Leiner said that in regard to the combination of iodin with arsphenamin medication, there is now a routine practice of this method in Vienna. It is seen that iodin enhances the effect of arsphenamin given intravenously.

Major Jarvis (by invitation) said that Dr. Nicholas Schenk of Chicago had noted the absence of tuberculosis and of skin diseases among the Eskimos. This is due to the large amount of iodin in the blubber and fish which form their staple food. These people fall prey to tuberculosis and respiratory diseases when they come to a temperate climate.

Dr. Foster Kennedy said that Mr. Hoover put an end to the epidemic of adolescent tuberculosis in Belgium by increasing the fat ration.

Dr. Farnell (closing) said that this work was experimental. He first tried giving large doses of potassium iodid intravenously; but it caused thrombosis from irritation of the vein lining. He then tried injection of 400 grains (25.7 gm.) of sodium iodid in a case of oidiomycosis. The patient was comatose for a day, but recovered without any ill effects. The man was cured of lesions of the lung and of the central nervous system. The sodium salt injection was apparently harmless.

BOSTON SOCIETY OF PSYCHIATRY AND NEUROLOGY

Regular Meeting, Nov. 17, 1921

James B. Ayer, M.D., *President, in the Chair*

SCHIZOPHRENIC DETERIORATION: BIOCHEMICAL STUDIES AND PRESENTATION OF CASE. Dr. Karl M. Bowman.

The case I desire to present is that of a boy, aged 15 years, whose father had had a somewhat similar condition when he was this boy's age; but he has apparently recovered and has gotten along fairly well in life. This boy has never been rugged and has been afraid of other boys because they were stronger physically. In December, 1920, although no sudden change was noted, the boy commenced to lose weight. He left school because of his weakness and loss of weight and later on came into the hospital. He has been rather quiet, self-centered and seclusive since an early age, and has been much wrapped up in his own thoughts, though it is not entirely clear just what these ideas are. The tendency to day dreaming apparently is not far advanced. He complains of dizziness, poor appetite, headache and various bodily symptoms. He has had fits of irritability, during which he has broken things, and also spells of crying.

Examination showed that he was not well developed physically and had poor chest expansion; his blood pressure was: systolic, 115, diastolic, 78. His fingers were long and graceful. He had no axillary hair and the pubic hair was of the feminine type. Results of examination by internists and by nose and throat specialists have been entirely negative. Laboratory tests showed that his basal metabolism on four different occasions was —24, —31, —37 and, following the feeding of thyroid extract, one grain a day for two weeks, —25. A roentgenogram of the sella was entirely normal. The blood chemistry was within normal limits. Spinal fluid, urine and blood examinations were negative. This case is taken as an example of investigating from the physical standpoint in order to correlate, if possible, certain physical findings with some of the mental states.

A further investigation along these lines was made on nine patients with dementia praecox, seven of whom had dementia praecox of the paranoid type and two of whom were hebephrenic. They all had cases of long standing. It was felt that laboratory studies over a certain series of cases might reveal to us the possibility of certain definite laboratory findings which would be constant in all cases. If not, we felt that consistently negative findings would be an equally valuable observation or even a marked scattering of results would be valuable. What we did was first to take twenty-four hour specimens of urine which were examined quantitatively for acidity, total nitrogen, ammonium nitrogen, uric acid and chlorids. Some of our findings were low and some were high, and there was no constant feature in the urine findings. This merely confirms Dr. Folin's findings as far back as 1904-1905. Next the blood chemistry was studied. We made quantitative examinations of the nonprotein nitrogen, dextrose, uric acid, chlorids and carbon dioxid combining power. In the nonprotein nitrogen test all but one fell within normal limits. In the dextrose test three were above normal limits and there seemed, perhaps, a tendency for the sugar to run higher than normal. In the uric acid test the findings were within normal limits. In the test for chlorids the findings, with the exception of two, were within normal limits, and those were close to it. The carbon dioxid combining power of the blood was within normal limits. The blood sugar tolerance curves showed great variation with no constant type of curve, but a considerable number were definitely abnormal. The basal metabolisms were ascertained. For two these were between 0 and + 3, and the rest fell below 0. One was —8. Three were between —10 and —19, two were —20, and one was —27. This we thought was of some significance, and in view of the case presented this evening it would seem that this point is worthy of further investigation. The renal function test was performed and showed the lowest result as 62 per cent.; all were, therefore, quite normal. The Goetsch test was negative in every case. The hemoglobin was tested in all cases, and the findings were entirely within normal limits. The red cell counts were high, the white normal. We felt that in reviewing these findings we had a definite tendency of the basal metabolism to fall below the normal, and we had a large number of abnormal sugar tolerance curves but no constant picture. The other findings all seemed essentially negative.

DISCUSSION

Dr. C. Macfie Campbell: Dr. Bowman's observations are of great importance because in these deteriorating cases we are dealing with a type of disorder which is of great severity, extremely frequent and of great social importance. After all, the greater number of patients for whom the state is responsible are those with cases of deterioration of which this boy's case is one type, and therefore it is one of our most important problems. The tendency in studying these cases has varied from time to time. If autointoxication was in vogue, the physician looked for autointoxication. Focal infections attained importance, and he took out teeth and pruned the individual in general. The *libido* later claimed his attention, and he traced the libido from its genesis to its maturity. There are few patients who have been studied in their entirety. As a rule, the presentation of a case has been from one aspect. Perhaps of the greatest importance at the present moment is the study of such patients in toto, to see if at the root of their emotional difficulties there may not be some disorder which we may formulate in simpler terms. Each man is different from his neighbors. Are we going to formulate his constitutional traits and maladaptations in complex terms of the emotional life, or can we find the key to these traits and to the disorder in metabolism or the chemical energies of the system? We study this patient from this standpoint and find that his basal metabolism is low. Is that one of the fundamental component factors which produce the total fault? In his emotional life is his limitation (lack of plasticity of the libido) largely due to the fact that some of the elementary components are lacking? The time may come when we shall not seek the etiology of these disorders in one popular formula or another but shall try to understand the constitutional endowment of the person both in its simple and complex factors.

Dr. J. B. Ayer: Has Dr. Bowman succeeded in raising the metabolism of these patients showing a low rate?

Dr. Donald Gregg: Has an early tuberculous infection been looked for in this case? Tuberculosis would give more or less the same picture.

Dr. Bowman, in closing: In only one case did we try to raise the basal metabolism. We started with 1 grain of thyroid, and then the patient decided that yeast would do him more good than thyroid, so we got no further. Regarding the interpretation of the sugar tolerance, I don't believe it can be interpreted. We have a number of different curves which are being variously interpreted. We know that in diabetes the sugar curve mounts up at the end of the first hour and does not return to normal at the end of the second hour. In hyperthyroidism and hyperpituitarism there is this diabetic curve. In hypothyroid and hypopituitary conditions there is the exact opposite type of curve, for at the end of the first hour there is almost no rise in the blood sugar, and at the end of the second hour it is entirely back to normal or below normal. I cannot see how one can make any interpretation of this great variation in findings. It is claimed by certain men that there is a typical curve in dementia praecox. This report does not confirm their findings. As regards the findings in early tuberculosis, my understanding is that there should be a certain amount of fever. In that case the basal metabolism would be definitely increased and not decreased. I have no knowledge of any work done in tuberculosis as regards sugar tolerance curves and assimilation.

HYSTERIA AND PERSONALITY. Dr. Martin W. Peck.

The patient presented showed personality disorder with recurrent hysterical states. The patient, a girl of 19, was admitted to the Psychopathic Hospital six months ago with nearly complete hysterical paralysis, aphonia, and a mental state of anxious, fretful hypochondria. There was a history of two similar attacks during a period of two years. After two months without change, she suddenly recovered and has since been in robust physical health and without somatic complaints. At the same time she developed a type of disagreeable behavior which has kept things in a turmoil, and has made it impossible for her to return home or to get on in other than hospital environment. She appears to derive her main satisfaction in teasing, ridiculing and interfering with those about her, but all is done in a mischievous and semi-playful, rather than malicious, manner. She also indulges in much troublesome horse-play, and is tiresomely talkative. Her past history proves that this conduct represents in a general way, her normal state since childhood. In play she did not get on with her mates; in school her unfortunate disposition was notorious; at home she antagonized the neighbors; and her working career included frequent changes of position and continuous petty friction of her own making. She showed lack of normal affection and absence of serious purpose in life. In appearance she was attractive and graceful; she had normal intelligence and considerable artistic ability. At no time had she been delinquent in the usual sense of the term, or shown tantrums of any order. While friendly enough toward physicians, it had never been possible to establish a sufficiently frank relationship to unearth the deeper factors in her character difficulties. The case was discussed from the standpoint of descriptive analysis and her personality defects outlined by grouping them in the fundamental spheres of reproductive, herd and self-preservative activities.

DISCUSSION

Dr. H. C. Solomon: I should like to ask Dr. Dewey and Dr. Walton what their attitude would be toward the commitment of this girl. Would they be willing to go before a court and ask for her commitment?

Dr. G. L. Walton: I should not be willing to commit her without further investigation. She appears to be a high grade imbecile. She has a hypermanic tendency, a lack of moral sense and pleasure in disturbing other people.

PRESENTATION OF CASES OF ORGANIC PSYCHOSIS (EPIDEMIC ENCEPHALITIS). Dr. Lloyd T. Thompson.

In the last two months we have seen at this hospital at least five cases in which the diagnosis of epidemic encephalitis is the most probable one, but owing to the fact that there is no epidemic of this disease at the present time and that these cases are somewhat atypical, the final diagnosis of that disease has not been made. The two patients presented are especially interesting because of the psychotic symptoms shown in addition to marked and changeable neurologic disturbances.

Number one is a man, 49 years of age, who was admitted with a complaint of tremor of the right arm and weakness of the entire right side. The onset was sudden, five weeks before admission, with dizzy spells, tremors, headache and dull pain over the entire right side. At one time there was blurring of vision.

He had a mask-like facies with weakness and hypesthesia of the left side of the face. The pupils were unequal and irregular but reacted normally. There was coarse tremor of the right arm and hand with weakness and incoordination on the right side. The deep reflexes were more active on the left side with a Babinski sign on the left. Reaction to pin prick was lost on the right side. The neurologic picture was very changeable from day to day. A double ptosis and paralysis of the left internal rectus developed. Repeated lumbar and cistern puncture showed only a consistent increase in the sugar content.

The patient was somnolent in the morning but became active toward evening. He became hallucinated and developed ideas of persecution. At one time he presented a typical manic condition with flight of ideas, elation, overactivity, etc. He was correctly oriented but showed impairment of memory and judgment.

Patient number two presented a similar history and changeable neurologic disturbances, but the mental condition was somewhat different. On admission his condition resembled very closely that in a case of catatonia with sudden outbursts of aimless excitement. A few days later his condition changed and seemed more like a depression. He admitted that he was very unhappy and worried, and there was marked retardation. The patient was hallucinated and had self accusatory ideas, but these symptoms have now disappeared.

These cases are reported to point out the possibility of sporadic encephalitis or the possibility that they may be the beginning of another epidemic. They also serve to illustrate the prominence of mental symptoms and the close resemblance to other forms of psychoses.

DISCUSSION

Dr. H. I. Gosline: Dr. Thompson said that the colloidal gold test was negative. What does this mean? It has been reported that the test did show some sort of a curve in cases of epidemic encephalitis.

Dr. D. J. MacPherson: To what extent is it true that increased sugar is present in epidemic encephalitis?

Dr. Harold E. Foster: In the series which we had at the Massachusetts General Hospital increased sugar was present in all our cases. In our fatal cases the sugar ran markedly high. It also ran very high in a case of encephalitis with acute retention. Syphilitic cases, especially general paresis, run fairly high but not as high as encephalitis, although they may overlap. In laboratory work it cannot be said that any one thing will make the diagnosis. I think the diagnosis of encephalitis can be questioned in any case that has run for any length of time with a normal spinal fluid sugar.

Dr. Thompson: The colloidal gold readings were actually negative except for a few changes to "ones." There is no characteristic reading for encephalitis. It may be anything from a negative to a "paretic curve." However, the changes that do occur are in the first five or six tubes and seldom in the tubes of greater dilution.

HISTOLOGIC EVIDENCE OF THE RESULT OF TREATMENT OF GENERAL PARALYSIS. Drs. Harry C. Solomon and Annie E. Taft.

The object of this investigation was to determine whether treatment of cases of general paralysis produced any effects that might be observed histologically. For this purpose a histologic examination was made of the brains from twenty-seven patients who had had general paresis and to whom treatment had been given. These were compared with the brains from a series of fourteen untreated cases. Sections were taken from twenty-four areas in each brain and stained by cresyl violet. Realizing that the histologic picture varies in different areas of the same brain, the twenty-four areas were studied from each brain and thus a fair idea of the situation could be obtained.

One striking feature of general paresis is the presence of plasma cells in the perivascular infiltrations and in the meninges. It is pretty generally accepted that plasmacytosis is essential for a diagnosis of general paresis. I show you a lantern slide picture from a case of untreated general paresis showing a small vessel surrounded by infiltration consistsing almost entirely of plasmacytes. This second picture from a case of general paresis in which the patient had received treatment shows some perivascular lymphocytic infiltration but no plasma cells. This is rather characteristic of the treated and untreated cases; namely, in the treated cases plasmacytes were comparatively rare as contrasted with the untreated cases. Sixteen of the twenty-seven treated cases showed practically no plasmacytic infiltration. Six showed a moderate amount, and five showed a considerable amount. Of the five that showed considerable plasmacytic infiltration two or three had received a fair amount of treatment and the other two had received very little. Contrasted with this finding were the findings in the untreated series of fourteen. Of these, nine showed a considerable degree of plasmacytic infiltration and five a moderate amount. None of them showed a slight infiltration as was found in the sixteen of the twenty-seven treated cases. The story concerning the perivascular lymphocytic infiltration is similar but not so marked. Twelve of the twenty-seven treated cases showed a slight infiltration, ten a moderate amount, while five showed considerable. It is worth noting that a number of the cases showed a fair amount of lymphocytic infiltration and slight plasma cell infiltration. In the series of fourteen untreated cases not one was relatively free from lymphocytic infiltration whereas nine showed a moderate perivascular lymphocytic infiltration and five showed a marked infiltration with lymphocytosis. A number of the brains had had the pia stripped before being obtained for examination. However, nineteen of the treated cases had the pia intact. Of these nine showed a slight pial infiltration, seven moderate, and three considerable. In eleven of the untreated cases it was possible to examine the meninges. Of these one showed slight pial infiltration, four moderate, and six considerable. As regards the pial infiltration, it is rather striking that three of the treated cases had a considerable amount of pial infiltration with lymphocytes. *A priori,* it would seem that the pial inflammation is readily amenable to antisyphilitic drugs, but histologic evidence in these cases points to the fact that there are cases in which the antisyphilitic remedy does not give satisfactory results even as regards the pial infiltration. As to the glia cell picture, there was no difference between the treated and untreated cases. One would feel that from the difference in the type of the plasma cell picture it is possible to make a fair estimate by a histologic examination as to whether the cases had received antisyphilitic treatment. We believe we are justified in drawing the conclusion that something has been accomplished by the treatment of cases of general paresis as shown by the histology, even though this may not have any clinical value.

DISCUSSION

Dr. H. I. Gosline: One slide seemed to show a certain paucity of nerve cells. Have such areas in treated cases been compared with similar areas in untreated cases? My reason for asking that is that I have noticed in carrying out this treatment that neo-arsphenamin will start a severe dermatitis and lead to cicatrization if one does not cover the fingers. Then again the cell count drops as a most constant and uniform occurrence. Does this arsenic act as a sort of searing process, killing off epithelial cells, and does the cured paretic patient get on because he has a sufficient number of nerve cells left to function although he has been injured?

Dr. Donald Gregg: What happened to the ten patients under treatment whose cases you reported a year ago?

Dr. Solomon: One of them has had a relapse.

Answering Dr. Gosline, I would say that we have studied these cases in a great deal more detail than I have attempted to present this evening. We have studied the glia cells, the white substance, the ventricular surfaces, the dropping out of cells and have also attempted to discover whether there is any relation to the age of the patient or with the duration of the process. I do not believe we will have any striking results. I cannot answer definitely why some patients die with a small amount of atrophy and some with a tremendous amount. As to the spinal fluid findings, we have had some rather disappointing results. Some of the cases in which the spinal fluid was practically free from cells during life show marked evidence of meningeal and perivascular infiltration. In one case particularly in which apparent cure had been accomplished, the serology was entirely negative, yet there was perivascular infiltration and meningeal involvement. Dr. McPherson asked me whether it was a good thing or a bad thing to lose one's plasma cells when one has paresis. I do not know. The fundamental study we should like to make would be on the amount of spirochetosis these brains show, but this is not possible at present owing to the technical difficulties in demonstrating spirochetes.

PHILADELPHIA NEUROLOGICAL SOCIETY

Regular Meeting, Nov. 25, 1921

George Wilson, M.D., *President, in the Chair*

A CASE OF BILATERAL EIGHTH NERVE PALSY, WITH PARTIAL RETURN OF FUNCTION AFTER TREATMENT. Dr. M. A. Burns.

This patient was again shown after the lapse of a year, because of the partial return of function after treatment. One year previously this man had been totally deaf in both ears. At the time of presentation he could hear with his right ear.

When treatment was begun the blood Wassermann reaction was + + + +; the globulin was markedly increased; there were 104 lymphocytes to the cubic millimeter of spinal fluid and the Wassermann reaction of the spinal fluid was + + + +. The blood Wassermann reaction now was + +; the spinal fluid Wassermann reaction was negative; the globulin was slightly increased and there were nine lymphocytes to the cubic millimeter of spinal fluid. Up to the time of presentation, the spinal cord had been drained thirty-five times; he had had forty intravenous injections of arsphenamin, as much as 50 grains (3.25 gm.) of potassium iodid every three hours and 2 drams (7.8 gm.) of mercurial ointment, daily.

Hearing began to return in the right ear in March, 1921, and when presented he could hear an ordinary conversation over the telephone.

DISCUSSION

Dr. Francis X. Dercum: This man was practically stone deaf when I first saw him in the clinic, and the return of hearing is very interesting. The case is remarkable because of the bilateral character of the lesion.

Dr. S. F. Gilpin: I have followed this case for a year with considerable interest because of the discussion which followed his presentation to the society a year ago. At that time the diagnosis made was syphilitic basal meningitis. Experience has shown that in neurosyphilis with an increased number of lymphocytes, the giving of intensive treatment accompanied by drainage of the cerebrospinal fluid produces results which cannot be obtained in any other manner.

A PATIENT WITH BULBAR PALSY AND AMYOTROPHIC LATERAL SCLEROSIS APPARENTLY FOLLOWING LETHARGIC ENCEPHALITIS. Dr. S. F. Gilpin.

D. L., a white man, aged 31, married, a laborer by occupation, was admitted to the Jefferson Hospital, Oct. 31, 1921. The family and past history were negative, except that he was an eight months' baby and was delicate until the fourth year. The patient denied all venereal history. He had healthy children. The present trouble began with an attack of influenza and pneumonia in the epidemic of 1918. Following this for about four months, he had a great desire to sleep. He worked for one or two days a week but was weak and fell asleep whenever he was quiet. He had no pain, he did not vomit, and there were no eye symptoms. In the fall of 1919, he noticed weakness in his right arm, accompanied by wasting of the muscles, which soon extended to the left arm. The arms had gradually become worse until at present the patient could not feed or dress himself. The legs became involved about the same time as the arms, becoming weak and stiff. The speech disturbance came on gradually with the other symptoms.

Examination revealed marked wasting of all the muscles of the upper and lower extremities. The legs were not wasted to as great a degree as the arms, and the patient was still able to walk, though his gait was weak and spastic. His pupils were equal and reacted normally. He stood well with his eyes closed. His tongue was protruded with difficulty, was wrinkled and showed atrophy. His throat muscles were weak and he had difficulty in swallowing. He had almost no use of his arm or hands. He showed exaggerated knee jerks, a bilateral Babinski sign and ankle clonus. He had no loss of sensation, of sphincter control or of sexual power.

REPORT OF A CASE WITH UNUSUAL SYMPTOMS PROBABLY DUE TO INVOLVEMENT OF THE ANTERIOR HORNS AND THE LATERAL COLUMNS. Dr. E. A. Leonard.

History.—The patient was an ex-service man, aged 29, and unmarried. He was drafted in May, 1918, after two attempts at enlistment and he was discharged, October, 1918, on a surgeon's certificate of disability. The family and past medical history were negative. According to the patient's mother, at 16 months of age, his left arm became suddenly useless without any other symptoms, such as fever or vomiting. At the time of this sudden loss of power in the left arm the boy was holding a potato when his hand suddenly relaxed and the potato fell from his grasp. There had been loss of power and wasting since that time. There was no history of pain.

Physical Examination.—The cranial nerves and pupils were normal. There was marked wasting of all muscles of the left upper arm and of the muscles over the chest, but not to such a degree as in the left arm. The wasted muscles were the seat of fibrillary twitchings. Both upper extremities were the same length; one was flaccid, but there was no failure of bony development. There was no disturbance of sensation. The reflexes in the left arm were present and showed slight exaggeration, considering the extreme degree of wasting. The reflexes in the right arm were about normal. The muscles of the legs showed some hypertonicity and no wasting. The knee jerks were exaggerated; the abdominal. plantar and cremasteric reflexes were normal and there was no ankle clonus. The electrical reactions, as tested by Dr. M. K. Myers, showed that the muscles of the left extremity had retained their faradic irritability; the biceps reacted normally to the galvanic current, but in the muscles of the left forearm an anodal closing contraction produced more reaction than the cathodal closing contraction.

DISCUSSION

Dr. S. F. Gilpin: The patient has no clonus or Babinski reflex, though his knee jerks are slightly active and he has had wasting of one arm for years. If he had, at 16 months of age, what appeared to be acute anterior poliomyelitis, would the patient's arm have developed in length as it has? One arm is as long as the other. The question arises as to whether there is a chronic anterior poliomyelitis which has developed after the acute attack or whether the present condition is the result of the acute poliomyelitis in childhood.

Dr. A. J. Ostheimer: I believe that the case is one of anterior poliomyelitis occurring in early childhood, on which there has now developed a chronic anterior poliomyelitis with the pathologic changes to a certain extent going over into the lateral tract. This whole subject was very thoroughly covered in an article by Dr. C. S. Potts, in 1903, published in the University of Pennsylvania Medical Bulletin. He reviewed the literature citing thirty-eight cases of early anterior poliomyelitis, which in later life gave rise to progressive muscular atrophy or amyotrophic lateral sclerosis.

CRURAL PARAPLEGIA OF CORTICAL ORIGIN. Dr. George Wilson.

History.—The patient, an ex-service man, aged 27, was wounded in the head by a shell fragment in France and was rendered unconscious for six days, after which he was paralyzed in both legs and had incontinence of urine and feces. He began to regain power in the legs eight months after he was wounded; and the control of the bowel and bladder returned at that time. His sexual power, which had been affected, also gave evidence of a revival at that time. He was able to walk, one year after the injury. He never had disturbance of pain, or of heat or cold sensations in the lower extremities.

Physical Examination.—The gait was spastic and was rendered somewhat bizzare because of a flaccid paralysis of both feet, which was practically complete. The rest of the lower extremities were weak but not paralyzed. Romberg's sign was not present. The deep reflexes of the lower extremities were exaggerated, with a bilateral Babinski sign but without ankle clonus. The abdominal and cremasteric reflexes were normal. Except for slight disturbance of the sense of position and tactile localization in the toes of the left foot, there was no impairment of sensation.

The case was of interest from two points: first, because of a spastic paralysis of both legs due to injury of both leg centers, and, secondly, because of the paralyses of the bowels, bladder and sexual function due to cortical lesions. The case will be reported in detail with a case of cortical crural monoplegia.

DISCUSSION

Dr. Charles K. Mills: This case is interesting from the standpoint of cortical localization. While it is true, as Greenbaum and Sherrington and others following them have reported, that there are centers in the upper motor region, on the lateral or mesal side of the hemisphere near its edge, still we have comparatively few cases of disorder of the bowels, bladder and sexual functions from unilateral lesions of the cortex. The probable explanation of this is that for functions of this sort, centrally exhibited, as for other functions, more or less bilaterally expressed, the center in one hemisphere may function for both sides of the body, or for its central region in which are included the bowels, bladder and sexual organs.

UNUSUAL SEQUELAE OF EPIDEMIC ENCEPHALITIS (LETHARGICA). Dr. Alfred Gordon.

History.—A girl, aged 11, became ill in January, 1921, with a sore throat, marked tremor of the hands and a temperature of 99.5 F. The following day, the tremor became generalized and there occurred an attack which the parents called a convulsion. Two similar attacks occurred two days later. Her temperature rose to 101.5 F. and she became confused. On the fifth day, myoclonia was observed, which was diagnosed as chorea. From that time on, the patient became somnolent and her temperature rose to 102 F., with a pulse of 136, and the speech became indistinct. The knee jerks at that time could not be obtained. There was no cranial nerve involvement with the exception of a sluggish light reflex in the right eye. The condition remained stationary for several days. On the twentieth day some improvement was noticed. At that time, a lumbar puncture was made and the spinal fluid showed 34 lymphocytes per cubic millimeter. The Wassermann reaction was negative. The globulin test (Noguchi) was positive.

The patient showed slight improvement, but for many days complained of pain over the upper part of the spine. Twitching of the muscles of the body was evident and continuous; it was synchronous with her respiratory movements, which were quite rapid.

Examination.—Four months later, I examined the patient with these results: The arms were animated with regular rhythmic flexor movements, accompanied by supination of the forearms and flexion of the fingers. They were coincident with identical muscular contractions of the diaphragm, so that there was a synchronous movement of the upper abdomen and upper extremities. These movements were all quite rapid. The face presented spasmodic contractions confined to the muscles of the left side and only in its lower half. The facial spasm was not synchronous with the muscular contractions of the arms, but considerably more rapid. The patient held her head in a peculiar position, inclined forward at an acute angle. There was no fixation for the head and the trunk could be straightened without difficulty. The knee jerks were exaggerated. The pupils were unequal, the left larger than the right. The grip of both hands was poor and the thenar and hypothenar elevations were flattened. The respiration was rapid and the heart beat was 144 per minute. The blood pressure was 118, systolic. All vegetative functions were normal. Mentality was good.

Comment.—This was probably a case of epidemic encephalitis (lethargic) in which the third, seventh and tenth nerves were involved. The facial spasm indicated an irritative lesion of the seventh nerve, only of one half of it, however, since only the lower half of the face was involved. There was also an irritative state of the last four segments of the cervical cord. The diaphragmatic contractions also indicated an irritation of the phrenic nerve which originates in the fourth cervical segment. The flattening of the thenar and hypothenar muscles suggested some involvement of the cells of the anterior cornua of the lower cervical segment. The irritative lesion was either in the roots of the nerves or else in the central portion of the cervical cord, although the cervical pain favored the former. The lesion was certainly partial since not all the muscles supplied by these nerves were involved.

CHICAGO NEUROLOGICAL SOCIETY

Regular Meeting, Dec. 21, 1921

C. F. READ, M.D., *President, in the Chair*

A CASE OF HABIT SPASM OF THE MOUTH AND TONGUE. DR. HUGH T. PATRICK.

History.—A temperamental woman, aged about 50, who had given public readings since childhood, had led a practically normal and uneventful life until November, 1919, when her husband died of heart trouble very suddenly, in her presence. She was greatly shocked. Following her husband's death, she was much depressed and very unhappy; she did not wish to see people so she went into the country and was quite solitary for a time. During this period, when urged to take nourishment, she said she felt as if she could not eat, but she did eat. There were no very striking symptoms until June, 1920. She then began to have difficulty in mastication, being unable to close the jaws. When she was about to eat her jaw would drop spasmodically and she would have trouble in closing it. This condition had persisted; but three months previously, it began to improve and at the time of presentation it was considerably better. In June, 1921, she began to have difficulty in articulation, which was rather complicated. First, there was difficulty with the jaw; the mouth opened very widely and she had difficulty in closing it. It remained wide open for several seconds before she could talk, and this spasmodic depression occurred at intervals as she proceeded. There was also difficulty with the lips and tongue, the tongue being moved about in a most irregular way, often protruding beyond the lips and momentarily being held rigid. The lips were less involved but were pouted and retracted in irregular but coordinated movements.

When the patient expected to drink or eat, there was generally a sudden opening of the mouth, and the jaw was held that way for a short time. There was no trouble in the act of deglutition; but in masticating there was difficulty in prompt motion of the jaw. The movements of the tongue were clumsy, slow and irregular. It did not respond promptly or properly to the morsel of food. Although speech was irregular and interrupted, articulation was good. When unnoticed the patient could take a drink of water without difficulty and could eat with little trouble. Like a patient with spasmodic torticollis, she had a "restraining gesture." When she pressed up the chin with her hand she could speak with more fluency, although if she was thoroughly rested she spoke much better. She also spoke better when she was very much absorbed or in earnest.

It was not an easy case to classify. There was a striking resemblance to spasmodic torticollis in the restraining gestures and in the way in which the depressed jaw was held fixed for a few moments. Many features were like those of tic, but a tic persists when the patient is entirely at rest; it is quite spontaneous. This patient's trouble appeared only when she talked or ate. In that respect it resembled an occupation neurosis. Although in eating the tongue moved about in the most erratic way and occasionally the jaw closed with a snap, the tongue was never bitten. Therein it resembled a tic. The more self-conscious she was, the worse the abnormal movements. The more automatic her action, the more nearly normal.

Comment.—I have not had time fully to investigate the etiology of this case; but a few interesting points have been ascertained. First, there is nothing to indicate that the patient has had lethargic encephalitis. Second, there are no signs whatever of organic disease. Third, following the loss of her husband, she not only had business and financial difficulties but some very perturbing emotional conflicts. Fourth, and most interesting, her husband died as they were about to retire for the night and had removed his false teeth concerning which he had always been abnormally sensitive. With this sensitiveness she had been most sympathetic. As soon as the immediate commotion of the sudden death had subsided, she put everybody out of the room and compelled herself to put the plate of false teeth in place and arrange the mouth as she thought it should be. But she was haunted by a fear that something might go wrong; and when the remains in the casket were exposed for view she requested a friend to see if "the mouth was right." Unfortunately, the friend reported that "the mouth was wrong," when it was too late to change it.

A CASE OF TABES DORSALIS SHOWING ATAXIA OF SUDDEN ONSET. Dr. William H. Holmes.

The third series of the Index Catalogue of the Library of the Surgeon-General's Office, U. S. Army, issued in 1920, contains seventeen references to acute ataxia. Seven of the articles referred to were available to me. None of the articles consulted refer to acute ataxia in true tabes dorsalis; but doubtless many such cases could be found by extensive search. Textbooks on neurology mention that ataxia in tabes may appear suddenly and progress rapidly; but they are not very specific as to the period elapsing between an asymptomatic stage of the disease and a stage of complete paralytic ataxia. Maloney's monograph on tabes mentions several cases in which fatigue seemed to precipitate the ataxia. My case showed development of severe ataxia of the lower extremities in five days.

History.—The patient, aged 30, gave a negative history so far as the present condition was concerned. There had been a Neisserian infection ten years previously; syphilis was denied. He served in the Army during the recent war and was discharged in good physical condition. Prior to his marriage, two years previously, he drank heavily; afterward he drank on only a few occasions, the last time being about four weeks before the onset of the present trouble. At that time he drank about one-half pint (0.28 liter) of whisky. Three or four days after this episode, he suffered from sharp, shooting pains in the lower extremities which persisted for three or four days and then entirely disappeared. He had never had any difficulty in walking, nor paresthesias, visual disturbance, loss of sexual power, etc. For some months, however, he had noticed that urination was infrequent and that urine could be retained for twenty-four hours without discomfort.

Nov. 7, 1921, while following his occupation of salesman, he noticed numbness of both feet, legs, thighs and buttocks. The following day, the numbness was more pronounced and some difficulty in walking was experienced. The third day the subjective feeling of numbness and the ataxia were quite marked; although he was able to stand alone and to walk with slight assistance. November 11, the lower extremities felt quite dead and walking without assistance was impossible. He was first seen by his attending physician, November 12, at which time it required the assistance of two strong men to enable him to stand. In bed he was unaware of the position of his lower extremities. There was no pain in the legs nor tenderness on pressure, and no loss of sphincter control.

Examination. — November 13, the temperature was 98.6 F., the pulse 96. Results of examination of the nose, throat, heart, vessels and abdomen were negative. There was diffuse chronic bronchitis. The urine was negative. Blood counts and the Wassermann test were not made. The pupils were unequal in size, the left being slightly larger than the right. They were regular in outline and reacted promptly to light and accommodation. The ciliospinal reflex was normal; as were also the cranial nerves. There was no disturbance of speech. With the exception of the right biceps jerk, the tendon reflexes of the upper extremities could not be obtained. There was moderate ataxia, as evidenced by poor performance of the finger-to-finger and finger-to-nose tests and by a difference in the writing with the eyes open and closed. Sensation of all types and muscular power for all movements were apparently normal in the arms, except that deep pressure was not painful. Epigastric and upper and lower abdominal reflexes were brisk and equal. Sensation on the trunk was normal. Pressure on the testicles was not painful until the degree of pressure became extreme. Neither cremaster reflex could be obtained. Knee and Achilles jerks could not be obtained. There was normal plantar flexion. Both lower extremities were normally and equally powerful. Ataxia was extreme and was increased by closing the eyes. When the eyes were closed, the position of the extremities was unknown. Tactile sensation seemed perfectly normal and without tardy response. Pin prick was appreciated as painful over both extremities. Tactile discrimination was impaired. When two points were placed at right angles to the extremities, they were not correctly located unless separated by from 1 to 1½ inches (3.8 cm.). Bone vibration sense was decreased as compared with that of the upper extremities. Deep pressure was not painful. Only very large coarse movements of the great toes, ankles and knees were appreciated and then only apparently by reason of skin stretching. Standing alone or walking with the assistance of two men was not possible because of the severe ataxia. The spinal fluid was clear, contained 90 cells per cubic millimeter. Tests for albumin and globulin were positive. The Wassermann reaction was strongly positive and the Lange curve was typically syphilitic. The diagnosis was tabes, with the occurrence of acute ataxia. Ataxic polyneuritis complicating tabes was considered but was eliminated because of the complete absence of pain and tenderness, the negative history, and the presence of normal muscular power. The electrical reactions were not studied.

Course.—During the month which has elapsed since the examination recorded above, he has had frequent attacks of lightning pains. There has been a steady improvement and he is now able to walk with the use of a cane. He has had no treatment other than complete rest and mercury by inunction.

DISCUSSION

Dr. Hugh T. Patrick: I think these acute exacerbations of tabes are among the most interesting things connected with the disease. They present some practical features. Any nonprogressive or slowly progressive case of tabes may have one of these acute exacerbations; but, in my opinion, tabes never begins that way. The next thing is that, acute and severe as these cases may be, they do not necessarily carry a bad prognosis. This is exemplified in this patient who a month ago could not walk at all and now walks fairly well with a cane, even without a cane. In some of the severe cases, it looks as though the patient would succumb, but I have never known of one of these acute cases being fatal, although of course this may have happened. Sometimes they do not improve very much but remain nonprogressive. Many years ago, long before the days of the lumbar puncture, I saw a marked case in a small coal dealer, whose business called for a good deal of physical activity. Within twenty-four hours he became completely paraplegic, with marked sensory blunting to the nipple level and retention of urine. The case looked very grave indeed. He remained practically paraplegic; but for years after that he went about his business in a chair propelled entirely by the arms. He regained control of his bladder; his health was good, and he was as successful a merchant after losing the use of his legs as before.

The moral is not to be discouraged or to allow the patient to be discouraged about the outcome. Some cases of tabes begin rapidly but rarely do they so continue. In a case seen yesterday, the first symptoms began about a year ago, with numbness in the feet. The patient is now quite ataxic, with marked sensory disturbance and the trouble is much more marked than one would expect it to be in a year; but I have no idea the case will continue to progress at that rate. Such cases generally run a rapid course up to a certain point and then come to a standstill for an indefinite period or progress very slowly, just as ordinary tabes.

Dr. H. Douglas Singer: I recall a case in which the onset seemed to have been within one-half hour. I am not absolutely certain of the facts, for it is a long time since I saw the patient; but as I recall them, the man was out in a park sitting in a chair and when he tried to get up he was so ataxic he could not walk. He was unable to stand the next morning. It occurs to me that possibly a different kind of lesion takes place in such cases and that these acute ataxic disturbances should be compared with the acute muscular paralyses observed occasionally, which clear up—apparently neuritic attacks which involve only the motor fibers of some nerve. I wonder whether these acute ataxic disturbances are not somewhat of the same nature, with a different type of lesion from the more chronic ones of tabes itself.

INTRACRANIAL ANEURYSM. Dr. George W. Hall.

History.—A man, aged 45, an office worker, with no history of previous illness except whooping cough at 9 years, had been deaf in the left ear since childhood with no definite history of the cause. The onset of the present illness occurred in the latter part of 1918, with headache, dizziness and vomiting, accompanied by numbness in the right half of the tongue, numbness and burning sensation on the right side of the face, weakness and numbness in the right arm and weakness in the right leg, followed by a tendency to walk to the right. There was a history of diplopia at intervals for several days after the attack. A similar attack occurred in the latter part of 1919 and a third attack in June, 1920. The last attack was very severe and was associated with severe headache on the right. In June, 1921, another severe attack came on suddenly, associated with severe headache, dizziness and vomiting. The vomiting was projectile. After this attack, he again noticed the tendency to go to the right, accompanied by ataxia of the right arm and leg.

Examination.—The urine was negative, except for a few hyaline and granular casts and a trace of albumin. The blood Wassermann reaction was negative. The blood pressure was 180, systolic. The palpebral fissure on the right was narrower than on the left; the right pupil was smaller than the left. Analgesia was noted over the distribution of the fifth nerve; no bruit was heard on auscultation of the skull. A roentgenogram of the skull was negative.

DISCUSSION

Dr. Ralph C. Hamill: Were there any subjective head noises?

Dr. Hugh T. Patrick: How did you make the diagnosis of aneurysm?

Dr. Hall: The diagnosis of aneurysm was based on the presence of arteriosclerosis, recurrent attacks of a certain definite syndrome, and an apparently good condition between the attacks. These were associated with unilateral headache.

Dr. Harold N. Moyer: Why could it not be just an ordinary cerebellar tumor?

Dr. Hall: As I have just stated, the symptoms subsided between attacks and the attacks were rather apoplectiform in character; whereas in cerebellar tumor, extending over three years, there would be more positive evidences of a tumor and the symptoms would not subside as in this case. Also, the optic disks were normal, excepting slight tortuosity of the vessels.

Dr. Hugh T. Patrick: If we are to make a diagnosis of intracranial aneurysm on this syndrome I believe we shall make it oftener than we have in the past. Brain tumors may cause these recurrent attacks. Why might not an aneurysm be a large thing by this time, like any other growth?

Dr. Hall: I am glad Dr. Patrick brought up the questions he did regarding the diagnosis because Dr. Wells will cover a great deal of the literature. I should like to cite one or two authors: Wichern (*Deutsch. Ztschr. f. Nervenh.* **44**:220, 1912) states that in fifteen of twenty-two necropsies there was evidence of previous leakage or rupture of the aneurysm on one or more occasions. He also calls attention to the unilateral headache accompanied by nausea, giddiness and vomiting and speaks of the sudden exacerbations with apoplectic onset of symptoms followed by varying periods in which no fresh developments appear. This in turn is followed by second, third and even fourth seizures. Multiple seizures were present in more than 31 per cent. of his cases. Beadles (*Brain,* 1907) states that the diagnosis of intracranial aneurysm is very difficult; but that if there is any one sign deserving special attention it is the intermittent character of the symptoms. Unruptured aneurysms usually are symptomless.

INTRACRANIAL ANEURYSM OF THE VERTEBRAL ARTERY.

Dr. H. Gideon Wells (by invitation).

This article appears as an original communication in this issue, page 311.

DISCUSSION

Dr. Peter Bassoe: In regard to the clinical diagnosis, it would seem to me that a bony groove such as Dr. Wells described might have been detected on stereoscopic roentgen-ray examination; and when the symptoms are suggestive, as in the case of Dr. Hall, this might help in the localization. Of course, a tumor may erode bone just as well.

Dr. Rogers and I recently saw a patient, a business man, aged 52, who had lost his left eye when he was 14 years old, and who, some years ago, had an attack in which he lost himself in the street, after which he was confused for a few hours, remaining in bed for a week. He had had a good deal of headache during the past five years, as well as attacks of dizziness. Three years before, he had had an attack, following which he dragged the right foot. Five days before I saw him, he had been out fishing on a hot day. He came into the boat house and had a severe attack of vertigo; it seemed to him that the boat house turned around. The next day his speech was thick; he could not swallow, could not walk alone and had spasms of the right arm and leg. The following day there were spasms of the right arm, and two days before I saw him, the third day after the dizzy attack, he had a general convulsion during which he was unconscious and had involuntary micturition. He had improved somewhat when I saw him.

The chief findings, when I saw him, were a bilateral Babinski sign; increased knee jerks, the left greater than the right; absence of abdominal reflexes, and arm reflexes, a little increased on the left. There was impairment of pain and temperature sense on the left side, not involving the face; ataxia of the right hand and a subjective burning sensation in the right side of the face, and no impairment of sensation on the right side. Speech was a little thick and he dragged the right leg in walking. The eye grounds were normal. There was no increase of cells in the spinal fluid; but there was a positive globulin test and a slight Lange reaction. The Wassermann reaction was negative.

Was it a brain tumor or a vascular lesion? My opinion was that he had a vascular lesion and I thought at the time that there possibly was a thrombosis of the left vertebral artery. The symptoms were complex and in part resembled those of a thrombosis of the left posterior inferior cerebellar artery, which is the principal branch of the vertebral. After some weeks, the patient grew worse and was taken to Dr. Walter E. Dandy in Baltimore, who kindly informed me that he performed an exploratory operation and discovered a large aneurysm of the basilar artery and great dilatation of the left vertebral artery. Later, these findings were confirmed at necropsy. There was considerable softening of the pons and medulla. Hence, the symptoms were probably the result of circulatory disturbance rather than of mechanical pressure by the aneurysm.

DISCUSSION

Dr. Arthur W. Rogers: Subsequent to the time Dr. Bassoe saw the patient, he improved so much that he went out on the lake fishing again. At 4 o'clock one morning, I was called and found him in much the same condition in which I had seen him four or five weeks previously. He was in coma; and for the first time I discovered noticeable eye symptoms. The internal rectus had become paralyzed and the good eye turned far out to the temporal side. Within four or five hours, consciousness returned and an oculist found nothing but the paralysis of the internal rectus. This ocular paralysis was on the side opposite the anesthesia.

Dr. H. Gideon Wells: Regarding help from roentgen-ray examination, I imagine this would ordinarily be of little service because Dr. Bassoe's case and this one are about the only aneurysms described in the literature that were big enough. I think Beadles, in his report meant miliary aneurysms. An aneurysm as large as this one would produce symptoms anywhere. I think the reason it reached such a size was that it occurred when the man was young, and there was enough depression produced at the base of the skull to permit its reaching a large size without producing fatal pressure effects.

Dr. Hugh T. Patrick: Another indication that Dr. Wells' case was very slow in developing was the absence of cranial nerve paralyses. From the location of the tumor, there must have been such palsies if there had been a rapid growth.

I entirely agree with Dr. Bassoe's diagnosis in his case. The patient may have had some symptoms due to the aneurysm but most of them undoubtedly were due to thrombosis in the pons.

Perhaps I may be allowed to add that twice I have ventured a diagnosis of intracranial aneurysm, neither case proved by necropsy. I based my diagnosis on more or less indefinite symptoms of tumor with tinnitus, synchronous with the pulse and a bruit audible to the examiner. The stereoscope placed close to the ear enabled one to hear a bruit. I had one other case in which there was very definite tinnitus synchronous with the pulse, not audible to the examiner and partial paralysis of the seventh nerve. I made a diagnosis of tumor, not aneurysm. Dr. Fenger operated. I think the symptoms in that case nowadays would have led to the diagnosis of cerebellopontile angle tumor, but it proved to be a sarcoma of the petrous portion of the temporal bone.

THE PATHWAY FOR VISCERAL AFFERENT IMPULSES WITHIN THE SPINAL CORD.* Dr. Loyal E. Davis.

Practically nothing can be definitely stated in regard to the course of visceral afferent impulses through the sympathetic system, the cerebrospinal nerves and their connections in the central nervous system.

Several cats were experimented on, and vasomotor responses were obtained from stimulation of the thoracic sympathetic nerve. Stimulations of the same nerve were effected in cats on which various lesions of the spinal cord had been produced at the second dorsal segment.

Dorsal hemisection of the cord which destroyed both posterior funiculi and posterior gray columns had no effect on pressor responses obtained from the thoracic sympathetic nerve. On the contrary, this type of lesion very definitely prevented a pressor response from stimulation of the sciatic nerve. This fact alone, therefore, rules out the posterior funiculi and any part of the posterior gray columns as the pathway for the conduction of this type of visceral afferent impulse. This is in contradistinction to the findings of Ranson and von Hess, working with somatic nerves, since they found the pressor pathway within the cord to be situated in the apexes of the posterior horns.

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Neither does complete lateral hemisection cause a disappearance of the pressor response to thoracic sympathetic stimulation. This is true whether the nerve on the side of the lesion or on the opposite side is stimulated. This strongly suggests that whatever the pathway within the cord, it obviously must be one which ascends partly on the homolateral and partly on the contralateral side. Section of the lateral funiculi, including a portion of one of the anterior gray columns, has resulted in a slight decrease in the height of the pressor response; but the characteristic rise still remains.

A lesion of the anterior funiculi had no influence on the blood pressure curve. The only lesion produced which destroyed this pressor response from stimulation of the thoracic sympathetic nerve was a complete transverse section of the spinal cord.

It is reasonable to presume, therefore, that the impulses arising from the viscera, transmitted through the thoracic sympathetic nerve and giving rise to vasomotor and respiratory responses, are conducted upward by relays of short spinal paths with synapses in the gray matter of the spinal cord. If this be true, they resemble fibers which convey pain sensation in the cat from the periphery. Since complete transection of the spinal cord at the level of the second thoracic segment eliminated the pressor response, it is obvious that the reflex arc is not complete within the spinal cord and that the visceral afferent impulses must reach the bulbar vasomotor center before they can become effective in producing a pressor response.

DISCUSSION

Dr. S. W. Ranson: There has been a great deal of work done in tracing the afferent somatic impulses through the spinal cord. But so far as I am able to learn, the experiments which Dr. Davis has just reported represent the first attempt to trace the course of visceral afferent impulses through the cord. It was theoretically possible that they could act directly on the spinal vasomotor centers, producing their effect through the cord. His results have shown, however, that this is not the case. These pressor impulses travel through the cord to the medulla oblongata and produce their effect through the bulbar vasoconstrictor center. This is also true of the somatic pressor impulses; but the visceral pressor path and the somatic pressor path are not the same. The somatic path is sharply localized in the apex of the posterior horn and in the tract of Lissauer, while the visceral path, as worked out in Dr. Davis' experiments, is obviously widely scattered through the cross section of the cord.

The study of visceral impulses is a new and largely unexplored field and a great deal of credit should go to Dr. Davis for making a distinct contribution to one of the underlying problems in this difficult field.

CORRECTION

In the title of the abstract of Dr. Cushing's article which appeared on page 263 of the February issue, the word temporary should have been temporal.

Book Reviews

BENIGN STUPORS. A Study of a New Manic-Depressive Reaction Type. By AUGUST HOCH, M.D. Cloth. Price, $2.50. Pp. 284. New York: The Macmillan Company, 1921.

The perusal of August Hoch's final work makes one doubly regret the untimely death of the author.

In this volume there is again evidence of the clinical acuity, the clear thinking, the constant searching beneath the surface which made him one of the acknowledged master minds of American psychiatry. It is particularly refreshing to note the full presentation of case histories and their keen analysis; the close insistence on the objective and subjective phenomena of the psychosis; the careful clinical observations and the freedom from glittering generalities. The study was not wholly completed by Hoch, and MacCurdy is to be commended for having edited the notes and brought them to light in their present form.

The monograph was prompted by Kirby's well-known observation that stupor in mental disease did not necessarily constitute a dementia praecox criterion. As the subtitle indicates, a benign stupor is a manic-depressive reaction type, and may be viewed as a recoverable psychosis which is characterized by inactivity, apathy, negativism, catalepsy, and a disturbance or abeyance of the intellectual functions. Partial stupors differ in degree but not in kind. The inactivity is not absolute, there is poverty of affect instead of affectlessness; negativism is less prominent. However, the intellectual processes are almost as markedly involved as in deep stupor. In patients in whom for an instant the curtain of apathy was lifted by a suicidal attempt there was also a brief modification from time to time of the other cardinal symptoms—thus revealing their close association and interdependence.

Probably the most valuable portion of Hoch's work is to be found in his study of the principal phenomena of the stupor not only by direct observation, but also in the light of the retrospective accounts of the patients; thus, we discover that intellectual functioning is of a primitive larval order and there is almost total amnesia both for external events and internal thinking. Comprehension and ideation are shallow, largely on account of the marked defect of attention. The ideational content of the stupor may be placed in a surprisingly narrow compass. In thirty-six consecutive patients, ideas of death were found in all but one; they were most common in the immediate prestuporous period. One-fourth of the patients gave a retrospective account of being dead, and the death concept is apparently often a clear simile for rebirth. "Naked came I from my mother's womb and naked shall I return thither." Apathy is the most important stupor sign. It is not at all the ultimate expression of depression and profound retardation, but constitutes an actual loss of affect and is as distinct a mood entity as are elation, sorrow, or anxiety. Inactivity is closely connected with apathy and, in fact, is its physical concomitant. It may be practically a total reaction, affecting even winking, swallowing and the sphincteric control. Retrospectively, one half of the patients spoke of feeling dead, numb, or drugged, and about 17 per cent. referred the phenomenon to external agencies. Catalepsy does not appear when the degree of inactivity is extreme, and it may be the result of a deadlock between suggestibility and opposition, both being equally strong. In any event, the indefinite maintenance of an awkward posture is surely a manifestation of preservation. Retrospectively, catalepsy often was recalled as an hypnotic influence.

The chapter on the "Physical Manifestations of Stupor" struck a somewhat discordant note. The observations were few and incomplete and are in regrettable contrast to the completeness of the psychologic aspects. For instance, blood pressure was read in only two patients, and blood examinations made in only five! Fever was present in twenty-eight of thirty-five patients. It is interpreted as a result of a failure of heat loss function, which is dependent on an imbalance in the involuntary nervous system, which in turn is due to insufficient circulating epinephrin which finally is traced to the apathy. Neither this ingenious explanation nor the attempt to deny these stupors even the most remote kinship with organic reactions are at all satisfying or convincing. It is unfortunate that an attempt was made to draw conclusions from premises constructed of insufficient and incomplete data.

Psychologically, a benign stupor is an example of the simplest and most complete regression. The level of the regression is an index of the depth of the stupor. Often it reaches an infantile stage as evidenced by masturbation, soiling and wetting. In this deepest form it is a dramatization of the death idea.

The chief points of differential diagnostic interest concern malignant or dementia praecox stupors. In these there is no apathy, but an inappropriate affect, the attention and interest are not unable to function but are redirected to primitive fantastic thoughts with a consequent perversion of energy and emotion as evidenced by giggling, rage, etc. Finally, the death motif is absent. Retarded depressions are clearly different. There are physical concomitants of emotional life to be seen in the facies and bearing. Furthermore, while the patient is morbidly aware of the difficulty in thinking and slowness, he can when urged often perform tests successfully. In perplexed states there is too much affect and not too little. In absorbed manias the sequence of the psychotic history furnishes a valuable guide.

Treatment of benign stupor must for the present be confined to constant observation, careful nursing, and feeding, and to stimulation to effort in every direction.

Hoch's monograph clearly measures the enormous step which has been taken beyond the restrictions of a narrow and sterile descriptive psychiatry. It is indeed sad that this must be the final message from the pen of such a remarkable and brilliant clinician.

ATLAS FOR ELECTRO-DIAGNOSIS AND THERAPEUTICS. By F. Miramond de Laroquette, M.D., Medical Director and Chief of the Electro-Radiologic Service of North Africa, Algiers. Translated by Mary Gregson Cheetham. Price, $4.50. Pp. 180. New York: Paul B. Hoeber, 1921.

This book contains little in charts or text that cannot be found on the bookshelf of any physician. The anatomic and physiologic discussion of the nervous and muscular systems, the joints, and the skin are quite elementary and of little value to the practitioner; unfortunately, they are also ambiguous and inadequate, and so would be of little value to one not already acquainted with the subject. For example (page 2), "Psycho-Sensory Motor Paths.—The psycho-sensory motor paths, or paths of conscious sensibility and voluntary motion, have the same sensory and motor peripheral motor neurons and the same peripheral conductors as the reflex paths, but they present besides medullary and encephalic paths more or less complicated. They are branches of the reflex arc, which comprise the multiple stages, crossings and spinal, bulbar, cerebellar and cerebral connections which all end in the grey cortical matter of the brain. All nervous actions are, moreover, reflex, for they have all at least one stage of reflexion in the grey matter (Laulanié)." Again (pages 7 and 8), "Motor Fasciculi: Direct Pyramidal Fasciculus.—Middle anterior portion of the spinal cord: comes from the cerebral cortex on the same side, forms connections in the corpus striatum, traverses the medulla without crossing, and ends in the anterior horns of the opposite side. Voluntary motion. Crossed Pyramidal Fasciculus.—Postero-internal portion of the lateral cord: comes from the cerebral cortex of the opposite side, and ends in the cells of the anterior horns of the same side. Voluntary stimuli and motor coordination. The other fasciculi composing the white matter of the spinal cord and brain are formed of commissural fibers, with a tract more or less long, which bind the right and left portions of the different stages of the cerebrospinal column."

Ninety pages, consisting mostly of plates, are devoted to the location of motor points and their corresponding muscles, each of which is named in the text. The origin, insertion, action, innervation, motor points, and N. C. Con. (negative closing contraction), and P. C. Con. (positive closing contraction), with one value for each, are given. A brief discussion covering the normal excitability of nerves and muscles is deferred to this point. Five tables, showing the electrical reactions in three cases of gunshot injury, one case of sciatic rheumatism, and one case of general neuritis, are interesting.

Sixty-one pages are devoted to a description of the various joints; the amplitude of movement, expressed in degrees, being given for each.

The last chapter of two and one-half pages covers the anatomy and the physiology of the skin. The inclusion of the word "therapeutics" in the title of the book is not only unnecessary but also misleading.

GUIDES FOR HISTORY TAKING AND CLINICAL EXAMINATION OF PSYCHIATRIC CASES. Edited by George H. Kirby, M.D., Director, New York State Psychiatric Institute. Published by the New York State Hospital Commission, Albany, N. Y. Pp. 83. Utica, N. Y.: State Hospitals Press, 1921.

This book can be heartily recommended; it fills a real need of students and practitioners entering on the practical study of psychiatry. It is essentially a revision and elaboration of the outline prepared several years ago by Dr. Adolf Meyer for use in the New York State Hospitals, with well selected additions, especially for the study of personality and endocrine disturbances. In spite of the somewhat appalling appearance of length and detail, the guides will be found eminently practical and sufficiently elastic to permit adjustment to the needs of the individual case. The danger of losing individuality and developing a stereotyped phraseology, inherent in all schematic plans for examination, has been fully recognized and guarded against by repeated warnings in the text. An examination made with the intelligent use of the outlines furnished will provide the facts needed, not only for classification but also for the far more important questions of treatment, prognosis and etiology.

With regard to details, it might be suggested that the section dealing with the history of onset and development of the psychosis is disproportionately brief in comparison with its fundamental importance. The omission of all reference to clinical laboratory investigations, except in the chapter dealing with endocrine disturbances, is striking, though perhaps justifiable. Typographic errors are somewhat numerous; the phrase, "may refuse to speak or answer," on page 62 should be corrected to "may not speak or answer." The paper tears easily and the volume is too large for the pocket, both of which are unfortunate in view of the manner in which the book will be used.

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CORTICAL MOTOR MECHANISM OF THE SHEEP BRAIN *

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BALTIMORE

INTRODUCTION

This paper is a part of a general study of the entire cortex of the sheep brain, the motor area alone being considered in this communication. The work has been carried on under the direction of Dr. Adolf Meyer, to whom I am grateful for guidance and much valuable assistance.

Marcacci,[1] in 1877, outlined in the sheep brain four excitable areas: first, the center for the opposite fore limb in the posterior part of the superior frontal convolution; second, the center for the muscles of the neck, stimulation of which caused the head to pull to the opposite side and in the male, a movement simulating butting; this center he also located in the superior frontal convolution in front of that for the fore limb; third, a center for movements of the facial muscles; no mention is made concerning whether these movements occur on the same or opposite side. He frequently noticed that associated with the movements of these muscles there were movements of the tongue. This area was located toward the outer side of the coronal sulcus, toward the anterior pole of the brain, in very much the same position as the center for movements of muscles of the same side of the face as determined by our stimulation experiments. On the extreme frontal pole of the brain at the anterior extremity of the coronal sulcus, he located the fourth center, that for movements of the mandible, stimulation of which caused movements of the jaw, simulating chewing.

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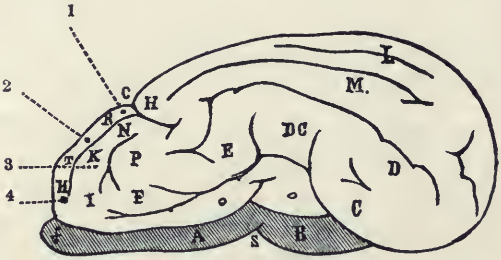
* From the Neurological Laboratory of the Henry Phipps Psychiatric Clinic, Johns Hopkins University.

* Read before the Forty-Seventh Annual Meeting of the American Neurological Association, Atlantic City, N. J., June, 1921.

[1] Marcacci, A.: Determinazione della zona eccitabile nel cervello pecorino, Arch. ital. per le mal. nerv., Milano **14**:34-38, 1877.

Ziehen [2] found that a center for movements of the opposite fore limb was in the superior frontal convolution, just anterior and posterior to the fissura splenialis and that for the hind limb was posterior to the cruciate sulcus (area perpendicularly shaded in Figure 2). Stimulation of the cortex lateral to the coronal sulcus resulted in raising the head, crossed shoulder movements and turning the head to the opposite side. This area like that for the hind limb extends behind the cruciate sulcus (area obliquely shaded in Figure 2). Stimulation of the cortex just lateral to this area, in the anterior region of the sulcus suprasylvius



Cervello di agnello veduto nella sua faccia laterale sinistra.

c. Scissura crociata.
s. Scissura Silviana.
o. o. Lobo dell' insula, allo scoperto.
B. Lobulo sfenoidale o mastoide.
A. Circonvoluzione olfattiva.
f. Bulbo olfattivo.
D. C. E. P. F. Circonvoluzioni temporali.
L. M. Circonvoluzioni occipitali.
H. Circonvoluzione parietale posteriore, post-crociata.
R. N. T. K. Circonvoluzioni parietali anteriori pre-crociate.
I. II. Circonvoluzioni frontali.

1. Centro motorio di flessione per l' arto opposto anteriore.
2. Centro motorio della cervice, e di cozzo.
3. Centro motorio della faccia e della lingua.
4. Centro motorio mandibolare.

Fig. 1.—Motor areas of the cortex of the sheep brain, after Marcacci.

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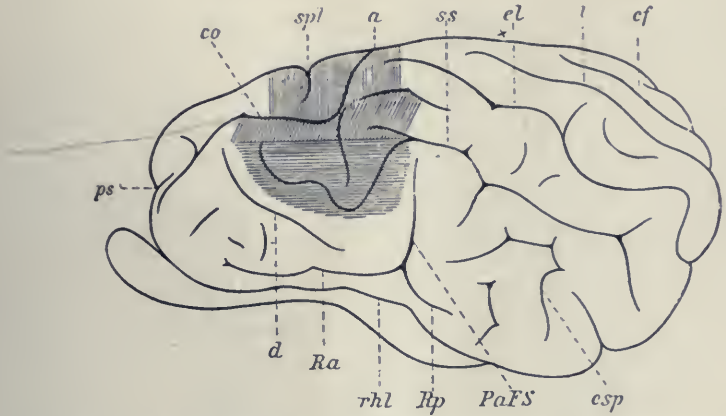
[2] Ziehen, T.: Ein Beitrag zur Lehre von den Beziehungen zwischen Lage und Function im Bereich der motorischen Region der Grosshirnrinde mit specieller Rücksicht auf das Rindenfeld des Orbicularis oculi, Arch. f. Anat. u. Physiol.; Phys. Abt., 1899, pp. 158-173.



Laterale Convexität des Schafhirns. Linke Hemisphäre, von der Seite und oben gesehen. *a* = „Bügel *a*“, *cf* = Sulcus confinis, *co* = S. coronalis, *d* = S. diagonalis, *el* = S. ectolateralis, *esp* = S. ectosylvius posticus, *l* = S. lateralis, *PaFS* = Processus acuminis Fossae Sylvii, *ps* = Sulcus praesylvius, *Ra*, *Rp* = Ramus anterior bezw. posterior der Fossa Sylvii, *rhl* = Fissura rhinalis lateralis, *spl* = Einschnitt der Fissura splenialis, *ss* = Sulcus suprasylvius. Bei × zieht eine grosse Vene über die laterale Convexität. Die Bedeutung der Schraffirungen ist im Text nachzulesen.

Fig. 2.—Motor areas of the cortex of the sheep brain, after Ziehen.

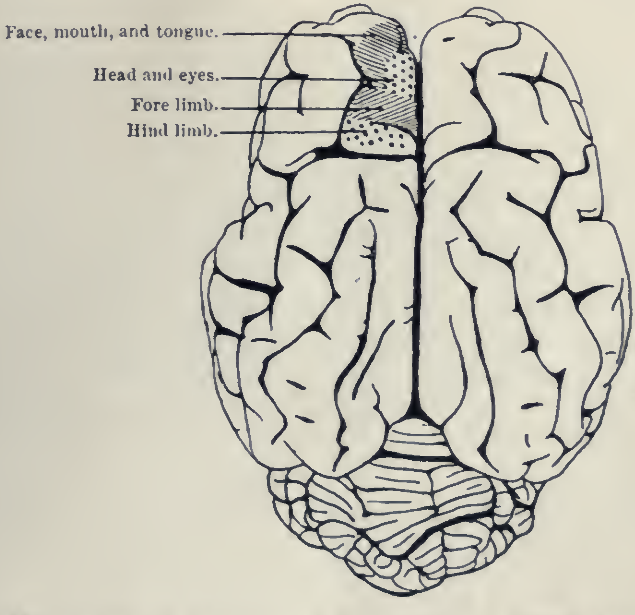


Fig. 3.—Motor areas of the cortex of the sheep brain (dorsal aspect), after Simpson and King.

behind the sulcus diagonalis, gave contractions of the mouth, eye, ear and face musculature of the opposite, and later also of the same side (area horizontally shaded in Figure 2). Somewhat behind the sulcus diagonalis he obtained contraction of the mouth-face muscles only; behind the latter area he found decided movements of the crossed ear and the crossed orbicularis oculi; contractions on the same side were not noticed. In this area he noticed a marked flow of saliva and sometimes mastication and movements with extension of the tongue (Fig. 2).

Several years later, Simpson and King[3] performed twenty-three experiments and concluded that the cortical motor area was located in the superior frontal convolution, that it extended from a line 2 mm. in front of the cruciate fissure behind to almost the frontal pole of the hemisphere, and lateromesially from the coronal sulcus over the mesial border, about 1 mm. on the mesial aspect of the hemisphere. They outlined four areas from behind forward for the hind limb, fore limb, head and eyes, and face, mouth and tongue, and concluded that the latter was the least excitable. In many individuals, motor responses were not obtained from one or more of these areas (Figs. 3 and 4).

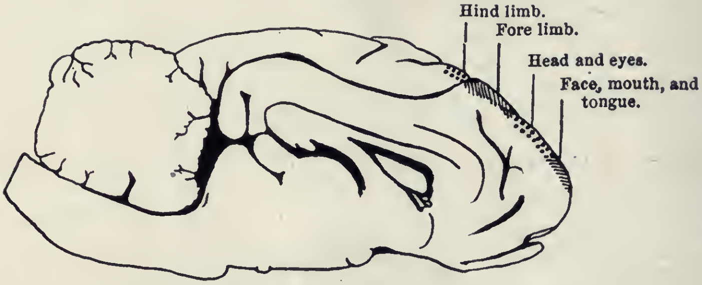


Fig. 4.—Motor areas of the cortex of the sheep brain (mesial aspect), after Simpson and King.

Leonardo Bianchi[4] located the center for the movement of the posterior and anterior limbs in the posterior portion of the superior frontal gyrus and that for the muscles of the neck and trunk, just anterior to these centers. To the outer side of the coronal sulcus in the posterior extremity of the midfrontal convolution, just anterior to the cruciate sulcus, he located the center for the opening of the eyelids. In the cortex just posterior to the cruciate sulcus, he located

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[3] Simpson, S., and King, J. L.: Localization of the Motor Area in the Sheep, Quart. J. Exper. Physiol. **4**:53-65, 1911.

[4] Bianchi, L.: La meccanica del cervello e la funzione dei lobi frontali, Torino, F. Bocca, 1920.

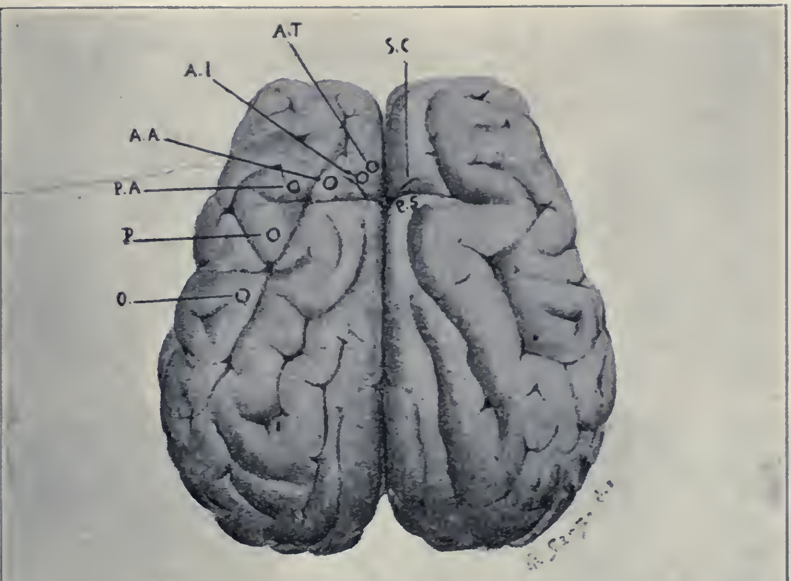

Fig. 38.

PS. Polo sagittale. — SC. Solco cruciato. — AT. Area di eccitazione della muscolatura della nuca e del tronco. — AI. Idem per l'arto posteriore. — AA. Arto anteriore con movimenti meno evidenti dell'arto posteriore. — PA. Apertura delle palpebre. — P. Chiusura delle palpebre. — O. Movimenti dell'orecchio.

Fig. 5.—Motor areas of the cortex of the sheep brain (dorsal aspect), after Bianchi.

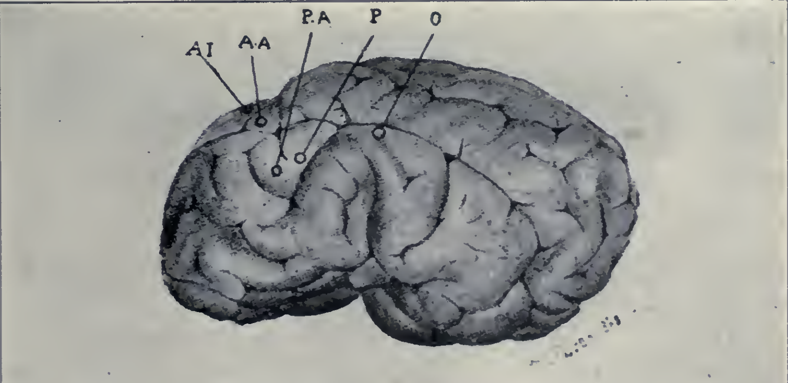

Fig. 39.

O. Area per i movimenti dell'orecchio. — P. Chiusura delle palpebre. — PA. Apertura delle palpebre. — AA. Movimenti dell'arto anteriore e un po' meno evidenti dell'arto posteriore. — AI. Movimenti dell'arto posteriore e un po' anche dell'anteriore.

Fig. 6.—Motor areas of the cortex of the sheep brain (lateral aspect), after Bianchi.

the center for closing the lids. Immediately lateral to the suprasylvian and opposite the upper extremity of the sylvian fissure, he located the center for movement of the ear (Figs. 5 and 6).

The course of the fibers from the motor cortex to the spinal cord was investigated by Dexler and Margulies,[5] who studied the pyramidal tract of the sheep in Marchi preparations after extirpation of almost an entire hemisphere. King[6] studied the pyramidal tract after extirpation of areas varying from the cortex of the superior frontal convolution alone, which she determined to be the excitable cortex (Figs. 3 and 4), to the areas in which the adjacent convolutions also were destroyed. King concluded that the pyramidal tract of the sheep was comparatively small; that the fibers of the pyramidal tract decussated in the lower part of the medulla and first cervical segments of the cord; that they could be traced into the reticular formation at the base of the dorsal horn and among the lateral horn cells as well as those of the dorsal part of the ventral horn. This was also true of the homolateral fibers. The tract could not be traced beyond the first

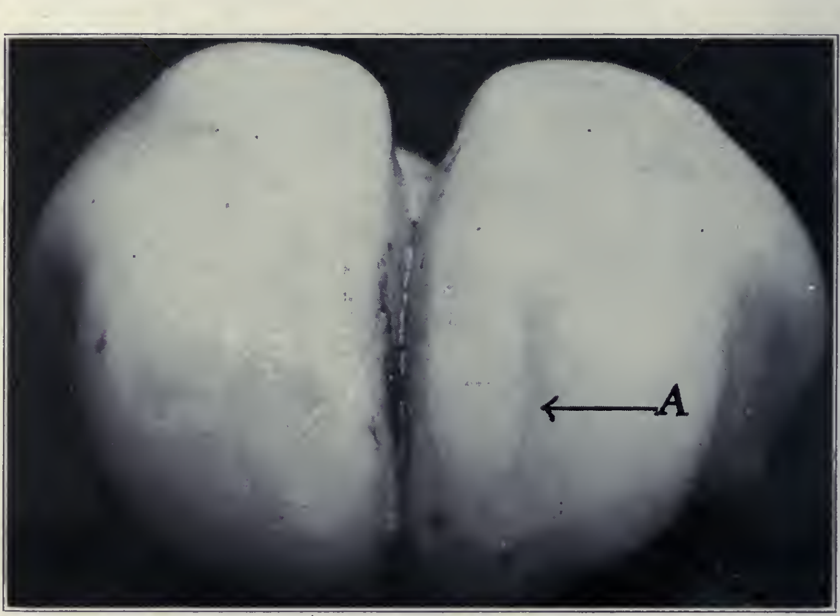

Fig. 7.—Frontal pole of the brain of the 15.5-cm. sheep embryo, showing the coronal sulcus at *A*, which marks the first indication of the motor area.

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[5] Dexler, H., and Margulies, A.: Ueber die Pyramidenbahn des Schafes und der Ziege, Morphol. Jahrb., Leipzig **35**:413-449, 1906.

[6] King, J. L.: The Pyramid Tract and Other Descending Paths in the Spinal Cord of the Sheep, Quart. J. Exper. Physiol. **4**:133-149, 1911.

cervical segments. An uncrossed ventral corticospinal tract could not be demonstrated.

King in describing the course of degeneration in sections made at various levels of the brain stem made no mention of degeneration extending into the tegmentum.

Dexler and Margulies [5] in their study of Marchi preparations of the midbrain, after extirpation of almost an entire hemisphere, mentioned an area of very fine degeneration which turned laterally and dorsally in the midbrain and was lost. They concluded that because of the great areas of softening which affected the thalamus after their extirpation, a definite statement concerning this degeneration could not be made. They also noticed a coarsely degenerated bundle, the fibers of which seemed to go through the raphé to the opposite side. The latter bundle and the preceding one fell outside their consideration, as the fibers did not reach the cord.

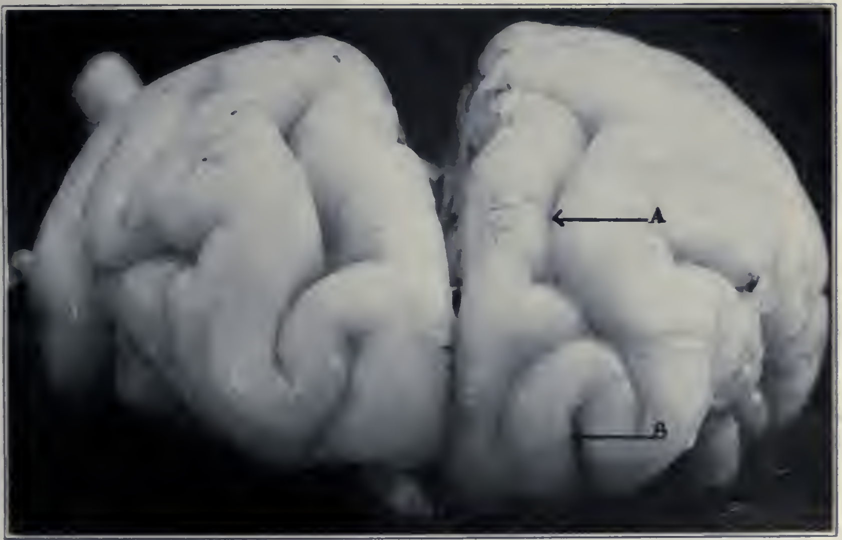

Fig. 8.—Frontal pole of the brain of the 30-cm. sheep embryo, showing the coronal sulcus *A*, with its various spurs and the anterior end of the presylvian sulcus *B*.

Dräseke [7] in Marchi preparations of the midbrain of *Vesperugo scrontinus* and *Pteropus ursinus* described a "proximal crossing" of the pyramidal tract and suggested that the fibers of this bundle were distributed to the nuclei of the motor cranial nerves. Merzbacher and

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[7] Dräseke, J.: Zur mikroskopischen Kenntnis der Pyramidenkreuzung der Chiropteren, Anat. Anz. **23**:449-456, 1903.

Spielmeyer[8] in work done on *Vesperugo noctula,* corroborated this finding, although they were in disagreement with Dräseke on other points.

Simpson,[9] in describing a frontal section of the midbrain at the level of the anterior corpora quadrigemina in Marchi preparations after

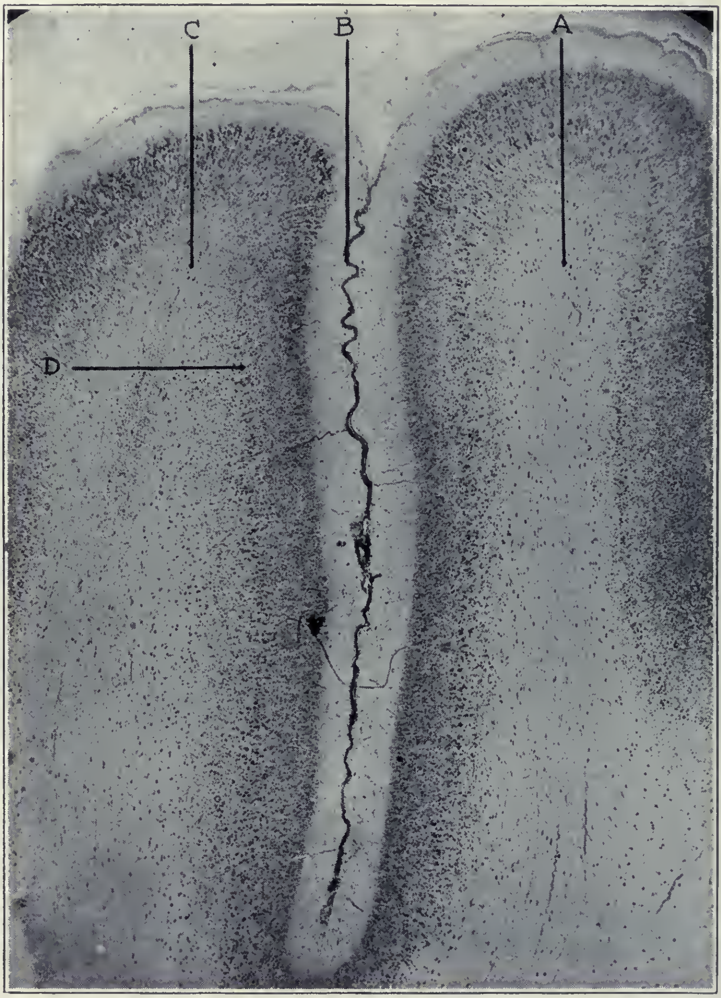

Fig. 9.—Section through the motor area of the 30-cm. sheep embryo: *A,* superior frontal gyrus; *B,* coronal sulcus; *C,* middle frontal gyrus. The layer of large pyramidal cells which extends throughout the superior frontal gyrus and stops abruptly in the middle frontal gyrus at *D* may be noted.

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[8] Merzbacher, L., and Spielmeyer, W.: Bieträge zur Kenntnis des Fledermausgehirns, besonders der corticomotorischen Bahnen, Neurol. Centralbl. **22:** 1050-1053, 1903.

[9] Simpson, S.: The Motor Areas and Pyramid Tract in the Canadian Porcupine (Erethizon dorsatus, Linn.), Quart. J. Exper. Physiol. **8:**79-102, 1915.

extirpation of the motor cortex in the brain of the Canadian porcupine (*Erethizon dorsatus,* Linn.), mentioned small fiber bundles cut transversely behind the main mass of the pyramid and running parallel with it. He also mentioned other fiber bundles which came off from the dorsal aspect of the crusta and passed backward into the tegmentum at right angles to the main mass of the tract. These fibers, he believed, terminated in the gray matter somewhere in the vicinity; but they could not be traced to any particular nuclei.

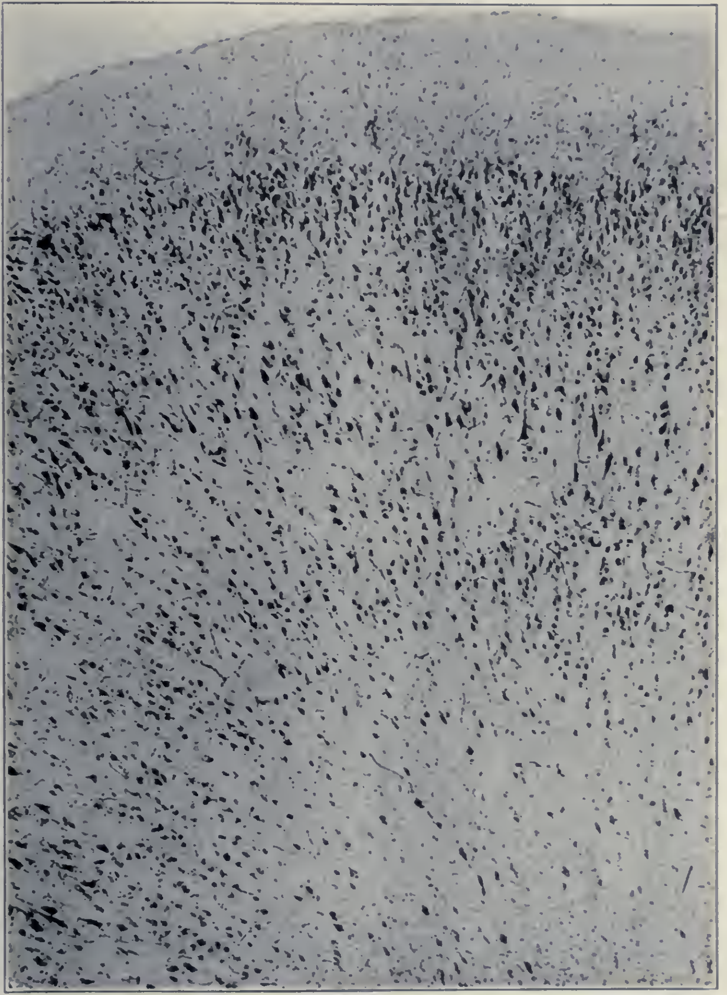

Fig. 10.—From the motor cortex at Area 1 in Figure 17. The first layer is relatively broad; the second layer is rich in cells, while the area between this and the layer of large pyramidal cells is narrow, indicating the absence of the granular layer. The large pyramidal cells are present in greater number than in other parts of the cortex; × 80.

Bregmann,[10] working with sections in the midbrain of the normal elephant, called attention to the importance of the fibers going to the facial nucleus, which nucleus plays a large part in the motor mechanism of the trunk. He found that two thirds of the fibers contained in the motor pathway from the cortex terminated in the facial nucleus. He called attention to the marked difference in the size of the pyramidal

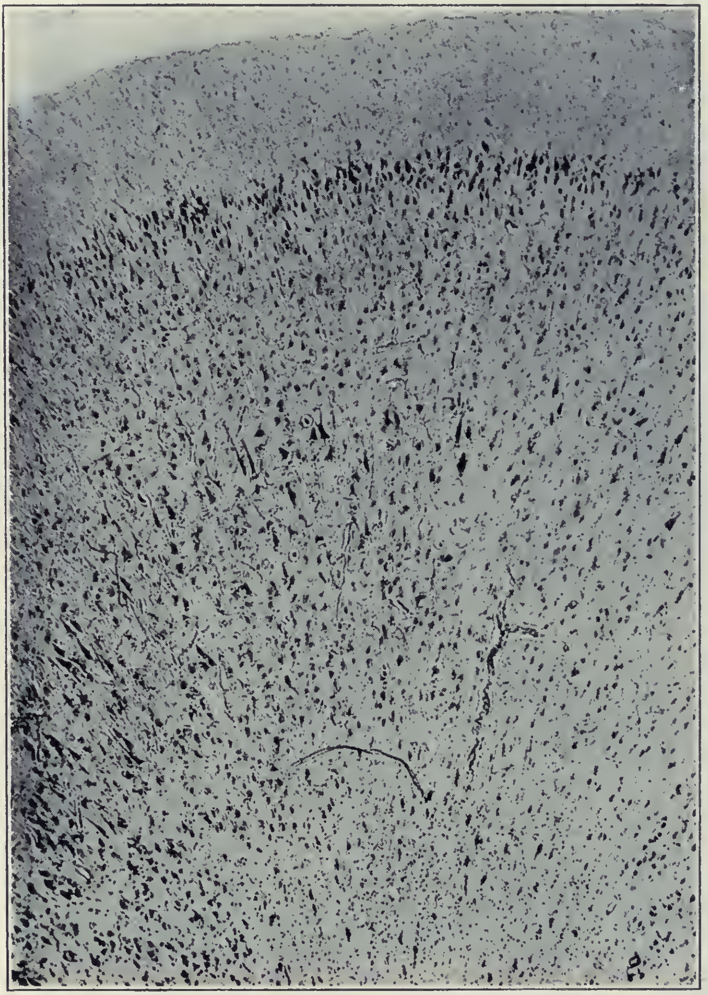

Fig. 11.—From the motor cortex at Area 4 in Figure 17. This differs from the cortex of the motor area as shown in Figure 10 in that the second layer is not so broad; the area between the second and fifth layers is broader; the fifth layer is not so rich in cells, and the individual cells are smaller; × 80.

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[10] Bregmann, L. E.: Neue Untersuchungen zur Kenntnis der Pyramidenbahn. 2. Die Oblongatapyramide des Elephanten, Anat. Anz. **48**:235-240, 1915-1916.

tract in a section through the anterior portion of the pons above the facial nucleus, and in another section in the caudal end of the pons after the facial fibers were given off. There was also further diminution in the pyramidal tract at the level of the olive so that he concluded some fibers were given off to the nuclei of the lower motor cranial nerves.

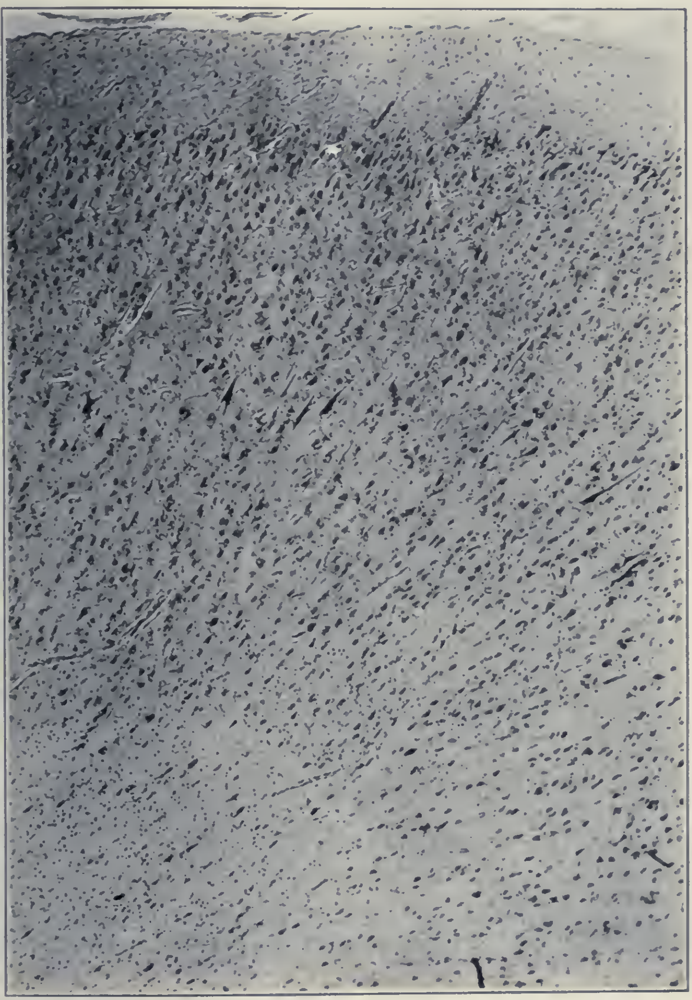

Fig. 12.—From the motor cortex at Area 5 in Figure 17. The cell structure is quite unlike that in Figure 10; × 80.

The work of Hoche,[11] in connection with two fatal cases in man in which there was softening of one cerebral hemisphere, has added much information to our knowledge of the corticotegmental bundle in the human brain. From his work, the fibers appear to pass through the internal capsule into the base of the cerebral peduncle and into the pons region where they are detached from the main mass of the pyramidal tract and take a position in the region of the lemniscus medialis. Fibers are given off to the facial and hypoglossal nuclei of the same and opposite sides.

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[11] Hoche, A.: Beiträge zur Anatomie der Pyramidenbahn und der oberen Scheife, nebst Remerkungen über die abnormen Bündel in Pons and Medulla oblongata, Arch. f. Psychiat. **30**: 103-136, 1898.

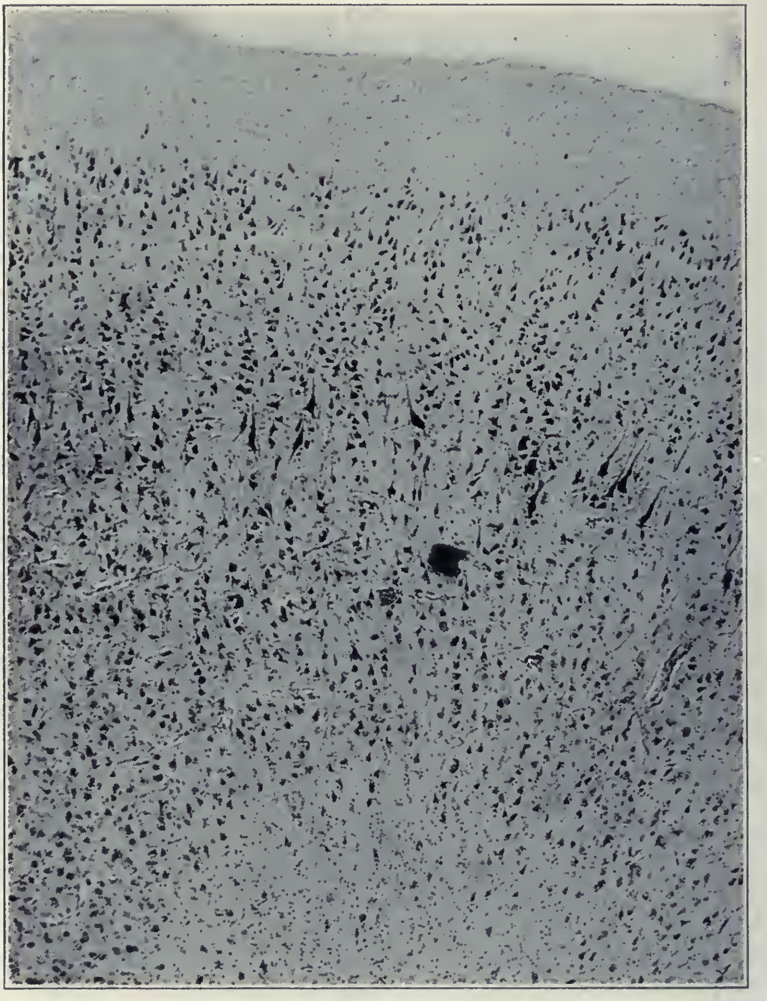

Fig. 13.—From the small gyrus at the outer extremity of the cruciate sulcus at Area 6 in Figure 17. This section resembles that of the motor cortex shown in Figure 10 in the rather broad zonal layer, the absence of a granular layer, and the presence of large pyramidal cells; × 80.

METHODS AND MATERIAL

The foundation of our work consisted of a complete survey of sections of the cortex, representing the cell structure, duplicated by sections representing the fiber arrangement. The cell and fiber structures were first studied in a series of frontal sections of the entire brain; in this series the variation of the angle at which gyri were sectioned made the study of lamination very difficult. In another series the gyri were dissected individually after fixation in liquor formaldehydi and then divided into blocks, which made cutting at a right angle to the surface possible in every block. If, for example,

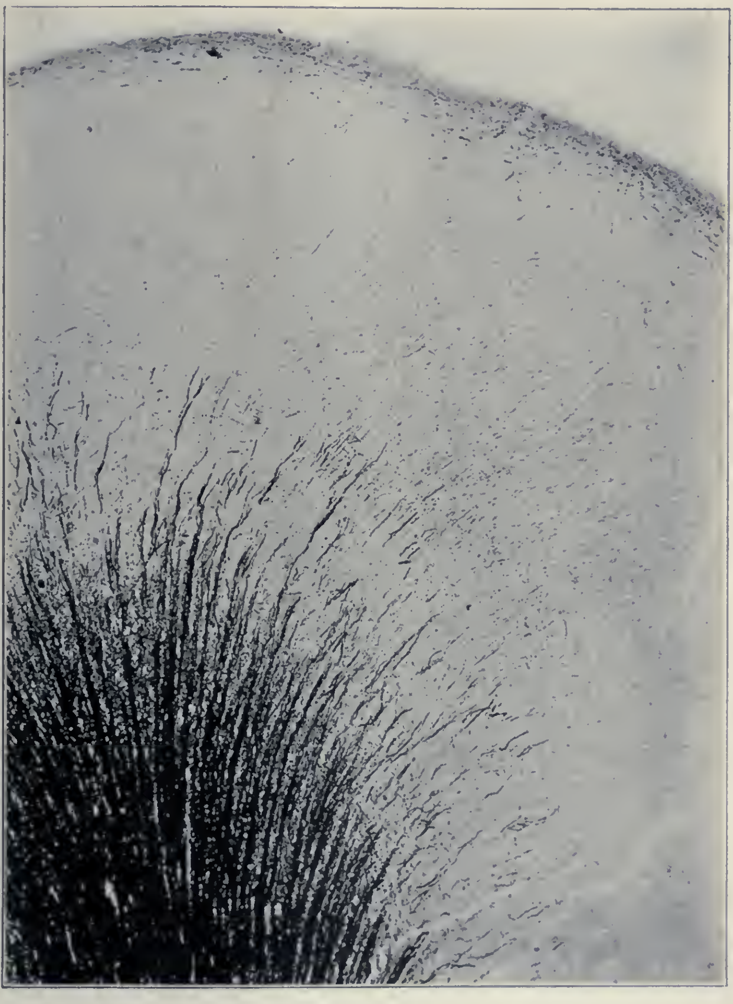

Fig. 14.—From the motor cortex at Area 2 in Figure 17. The broad layer of tangential fibers is characteristic of the cortex of the motor area; × 80.

there was a sharp curve in the gyrus, a wedge of tissue was sacrificed so that the remaining sections were cut at a right angle to the surface. The material for cell studies was fixed in 10 per cent. liquor formaldehydi, in some instances through carotid injection. The blocks were imbedded in paraffin and sections cut at a thickness of 20 microns and stained with thionin. The material for fiber studies was fixed in liquor formaldehydi and mordanted in Müller's fluid for six weeks, embedded in celloidin and stained by the Weigert-Pal method, and sectioned at 20 microns. After study of these sections an effort was made to outline the motor cortex; but because the histologic arrangement was not

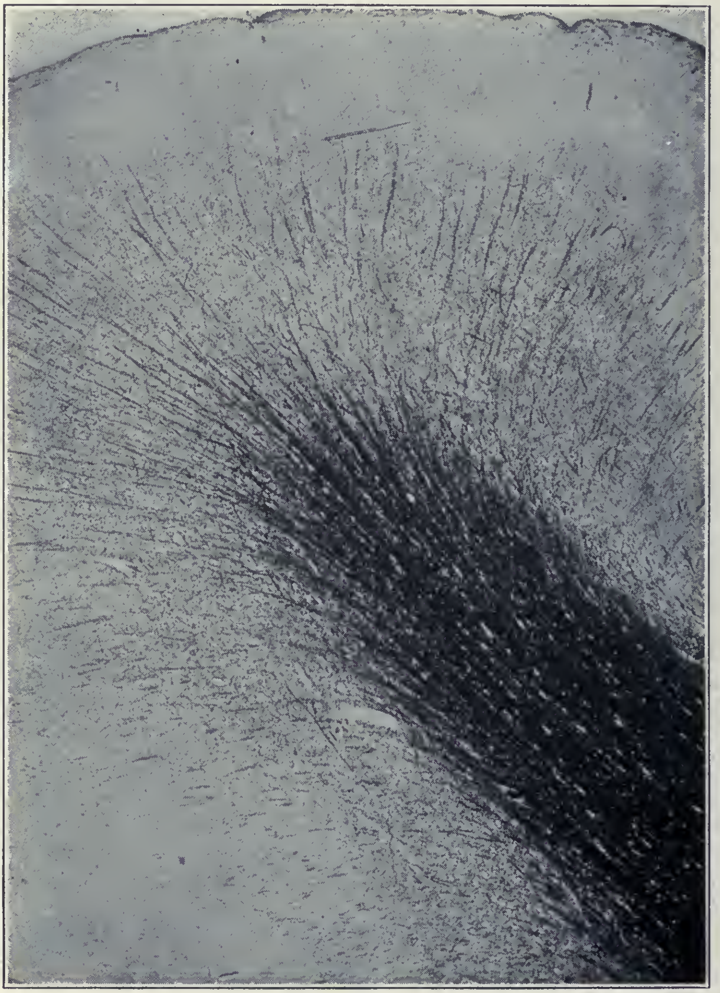

Fig. 15.—Fiber structure of the motor cortex at Area 5 in Figure 17. The narrow tangential layer of fibers may be noted; × 80.

altogether unequivocal, a series of stimulation experiments was undertaken. Under cocain anesthesia various parts of the cortex were exposed and stimulated by the bipolar method and the findings checked by the unipolar method; the Petzold coil was used and the current registered on the centimeter scale. Thirty experiments were performed on eighteen sheep.

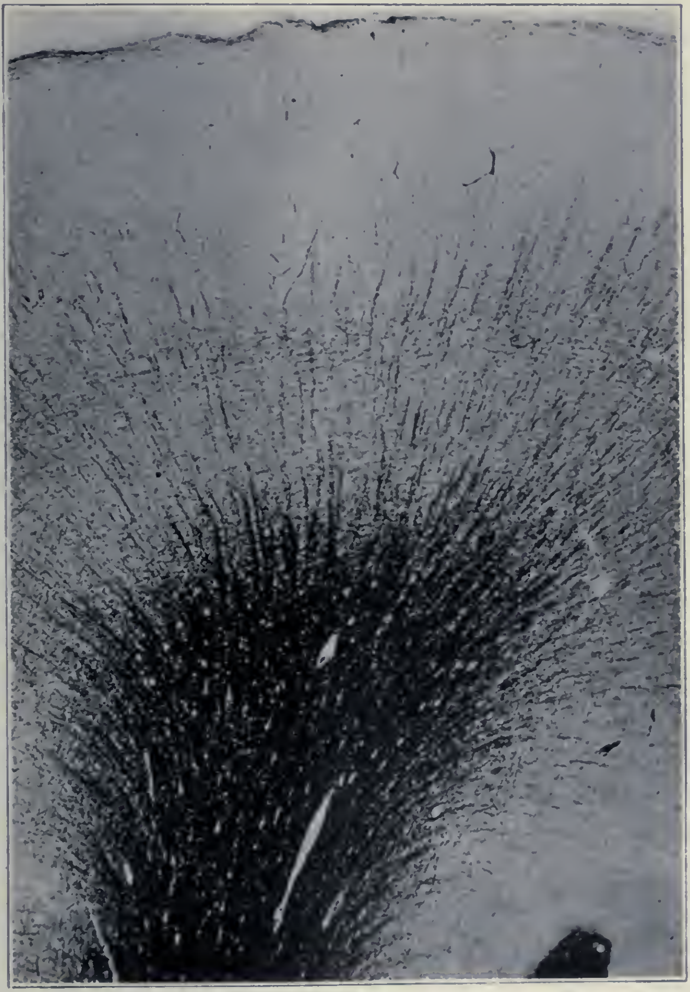

Fig. 16.—From Area 6 in Figure 17, showing the narrow tangential layer of fibers; × 80.

Extirpation of the motor cortex followed in the animal stimulated. The pia over the crest of the gyrus was divided and then gently peeled from the gyrus. This greatly reduced the danger of interfering with the circulation of the surrounding cortex or of direct injury to the adjacent gyri (Fig. 18). After extirpation the animal was killed in from twenty-seven to thirty days. The brains were fixed in Müller's fluid through carotid injection and immersion for from ten to fourteen days. Three millimeter blocks were then cut and stained by the Marchi method, when they were embedded in celloidin.

HISTOLOGIC STUDIES

To obtain the landmarks of the cortex the fissuration of the brain was studied in a series of fetuses; at full term the average head-rump measurement of the fetus was 50 cm. The hippocampal fissure appeared at a very early stage and the rhinal fissure in the 14.5-cm. embryo. In the 15.5-cm. embryo, the splenial sulcus was well marked; there was a broad depression at the site of the Sylvian fissure

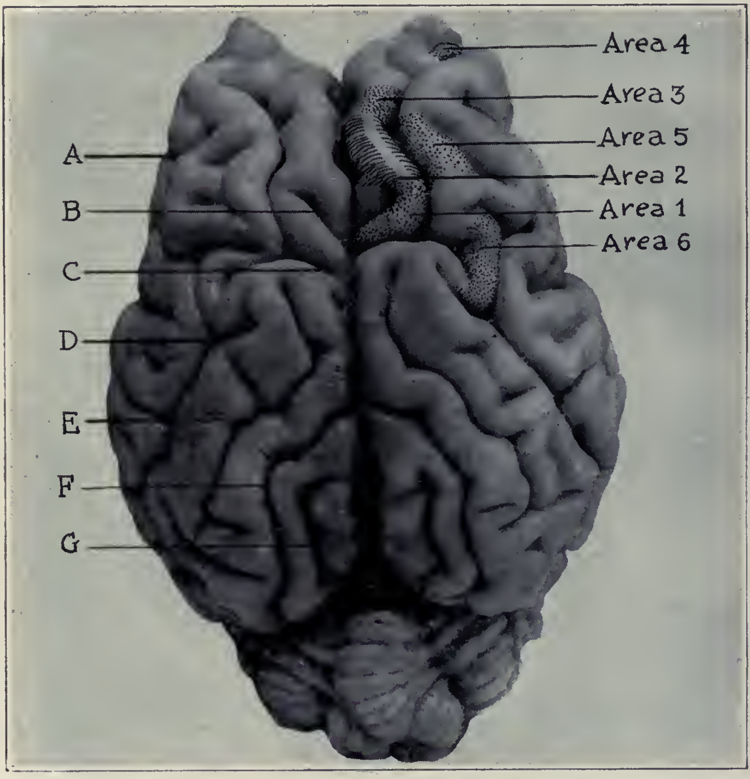

Fig. 17.—Dorsal surface of the sheep brain: Areas 1 and 2, centers for movements of the extremities; Area 3, center for movements of the head and eyes to the opposite side; Area 5, center for movements of the face muscles of the same side; Area 6, an area histologically of the motor type of cortex, but which gives no response on stimulation. *A,* sulcus diagonalis; *B,* sulcus splenialis; *C,* sulcus cruciatus; *D,* sulcus suprasylvius; *E,* sulcus lateralis; *F,* sulcus intermedius, and *G,* sulcus medialis.

and a slight, narrow, vertical depression on the anterior extremity, which was the beginning of the coronal sulcus (Fig. 7). At the appearance of this sulcus lamination had not commenced. In the brain of the 21-cm. embryo the beginning of lamination was seen very satisfactorily, while in the brain of the 24-cm. embryo, in which the coronal sulcus was already deep, the cell structure of the cortex presented definite lamination. There was found to be a very rapid progress in fissuration and lamination between this stage and that of the 30-cm. embryo (Fig. 8), in which the cell picture and the development of the coronal sulcus with its various ramifications approached that of the adult brain. The Betz cell layer of the brain of this 30-cm. embryo was particularly interesting in that it could be followed from the mesial surface of the superior frontal convolution over the crest into the depth of the coronal sulcus and almost to the crest of the "middle frontal" convolution, where it abruptly changed to a layer of small, thinly scattered cells (Fig. 9).

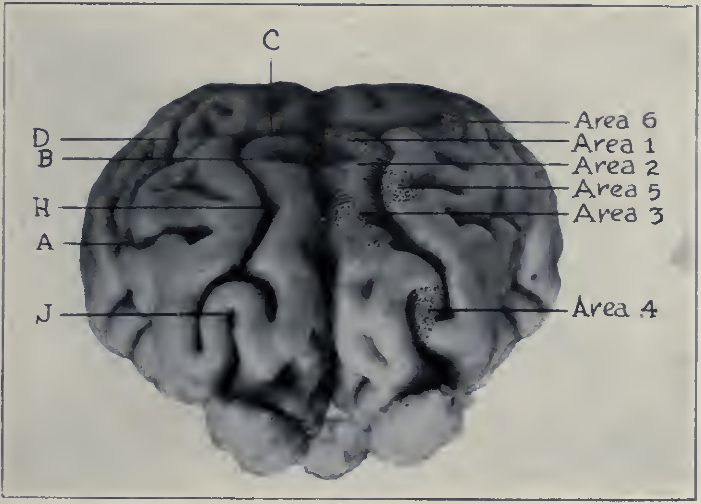

Fig. 18.—Frontal surface of the sheep brain: Areas 1, 2, 3, 5 and 6 as in Figure 17; Area 4, center for the movements of the face muscles of the opposite side: *A, B, C* and *D,* as in Figure 17; *H,* sulcus coronalis; *J,* sulcus praesylvius.

On the basis of cell types and lamination, eight distinct cortical areas were outlined in each hemisphere of the adult sheep brain; one of these areas, located on the superior frontal convolution, was designated as the motor cortex. Its chief characteristics were a broad first layer, a very rich second layer, a poor third layer, absence of the granular layer, while the fourth layer contained numerous large pyramidal cells which were slightly larger than the pyramidal cells of this layer found in other parts of the cortex and present in a much larger number. The fifth layer presented nothing distinctive (Fig. 10). Toward the extreme anterior portion of the superior frontal convolution the cells of the fourth layer were less prominent. The cell structure of the superior frontal convolution has been well described by King,[12] who concluded that it is characterized by elements analogous to those of the motor cortex of man. The portion of cortex bounded laterally by the outer prolongation of the coronal sulcus and mesially by the presylvian fissure (Fig. 14, Area 4) histologically presented some of the characteristics of the cortex of the superior frontal convolution in that there was a broad zonal layer, a narrow, though closely packed, second layer and prominent fourth layer (Fig. 11).

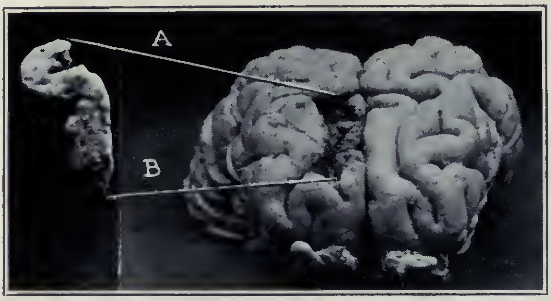

Fig. 19.—Frontal view of sheep brain from which the superior frontal gyrus has been extirpated between *A,* posteriorly, and *B,* anteriorly. The absence of injury to the surrounding gyri may be noted. The insert shows the superior frontal gyrus as removed intact from the brain.

The cortex of the "middle frontal" convolution differed from that of the superior frontal convolution in that the zonal layer was not so wide; the cells of the second layer were more loosely placed, while those of the fourth layer were much smaller in size and fewer in number (Fig. 12). On the mesial surface of this gyrus, however, the structure was very much like that of the superior frontal convolution. Adjacent to the posterior portion of the motor area, at the outer extremity of the cruciate sulcus, there was a small U-shaped gyrus, the fourth layer of which contained a few pyramidal cells which were larger than the pyramidal cells in the fourth layer of the superior frontal convolution (Fig. 13).

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[12] King, J. L.: Localization of the Motor Area in the Sheep's Brain by the Histological Method, J. Comp. Neurol. **21**:311-320, 1911.

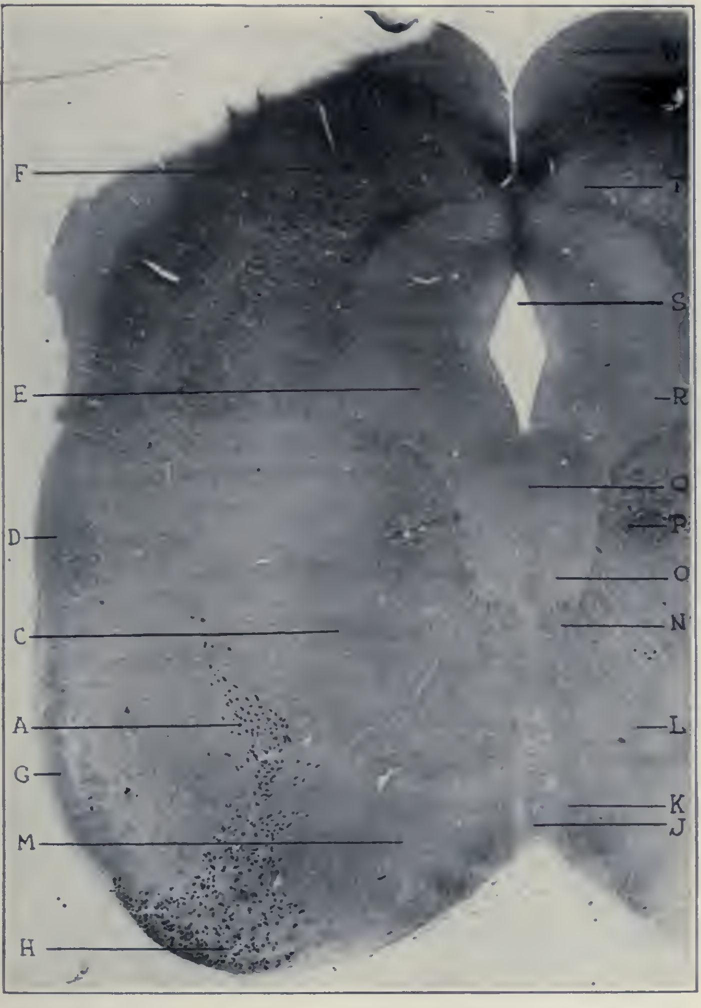

Fig. 20.—Degeneration in the crus after extirpation of Area 5 in Figure 17; the prolongation backward of the degenerated fibers *A* may be noted; these fibers later become isolated as the corticotegmental bundle; ×8: *C*, tegmentum; *D*, bracchium conjunctivum positcum; *E*, central gray; *F*, superior colliculus; *G*, tractus peduncularis transversus; *H*, cerebral peduncle; *J*, ganglion interpedunculare; *K*, root of oculomotor nerve; *L*, nucleus ruber; *M*, substantia nigra; *N*, posterior longitudinal bundle; *O*, oculomotor nucleus; *P*, thalamo-olivary bundle; *Q*, raphé; *R*, mesencephalic root of trigeminal nerve; *S*, midbrain ventricle; *T*, stratum medullare profundum; *U*, stratum medullare intermedium; *V*, stratum medullare superficiale, and *W*, stratum zonale.

The fiber structure of the superior frontal convolution differed from that of the surrounding cortex in that the tangential layer was much broader (Fig. 14). The tangential layer of the middle frontal convolution (Fig. 15), as well as that of the gyrus surrounding the outer end of the cruciate sulcus (Fig. 16), in which the large pyramidal cells were found, was very shallow.

STIMULATION EXPERIMENTS

As a result of the stimulation experiments we were able to outline five excitable areas (Figs. 17 and 18). Area 1 was located at the posterior extremity of the superior frontal gyrus between the cruciate sulcus and the indentation of the splenial sulcus. Area 2 extended from the indentation of the splenial sulcus forward for about 8 mm. Area 3, about 8 mm. in length, was in front of Area 2. Areas 2 and

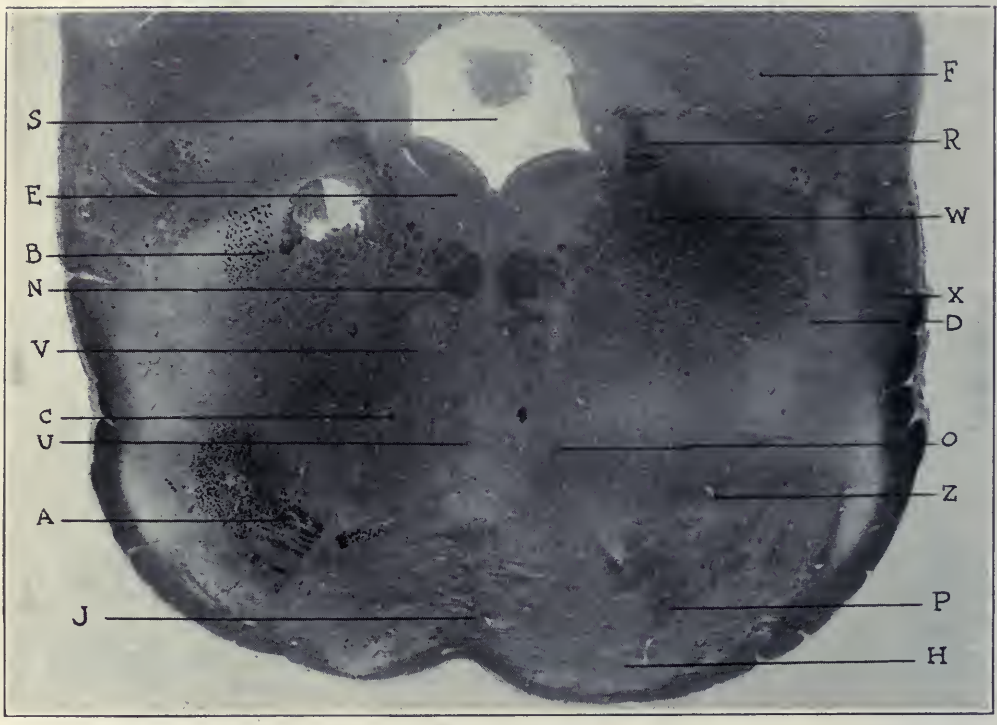

Fig. 21.—*A*, degeneration in pyramidal tract; *B*, isolated degeneration of corticotegmental bundle; *C*, reticular formation of tegmentum; *D*, superior cerebellar arm; *E*, central gray; *F*, inferior colliculus; *H*, pons; *J*, ganglion interpedunculare; *N*, posterior longitudinal tract; *O*, colliculospinal tract; *P*, corticospinal fibers; *R*, mesencephalic root of trigeminal nerve; *S*, midbrain ventricle; *U*, Forel's decussation; *V*, nucleus of Gudden; *W*, central tegmental bundle; *X*, lateral fillet, and *Z*, mesial fillet; × 8.

3 were sometimes separated by a small area of nonexcitable cortex; but in other experiments they were found to be continuous and in still others they were found to overlap. The anterior extremity of Area 3 never extended to the extreme anterior portion of the gyrus. Area 4 was located in the narrow convolution between the outer anterior spur of the coronal sulcus and the frontal end of the presylvian fissure. Area 5 was located in the portion of the middle frontal gyrus adjacent to the coronal sulcus. In most of the experiments this area was found

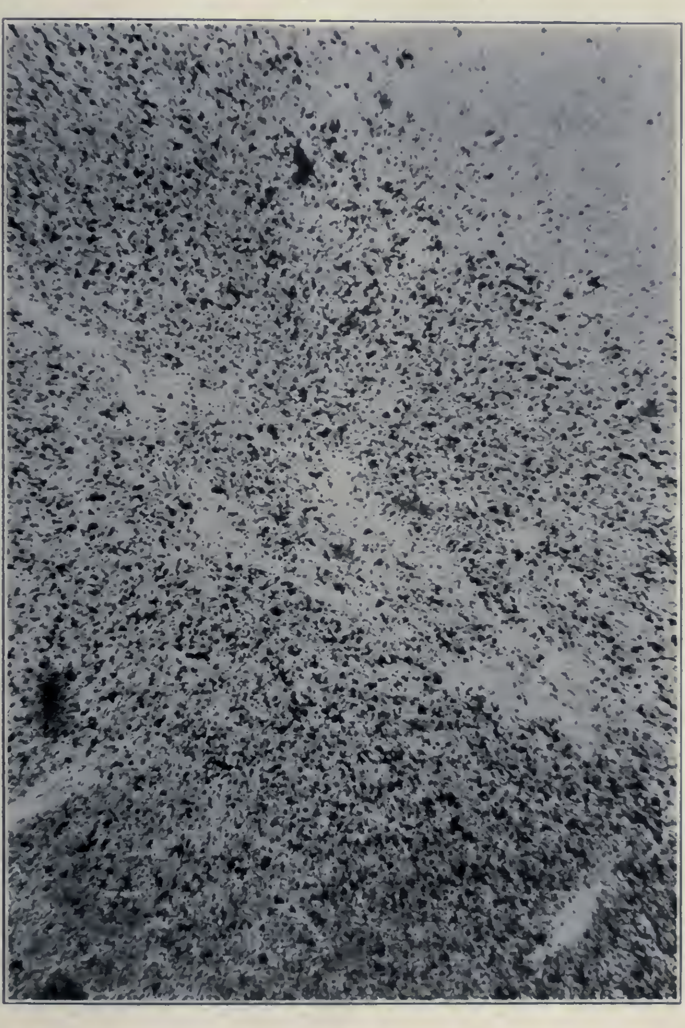

Fig. 22.—Photomicrograph showing the density of the degeneration at *A* in Figure 21; × 125.

to be about 1 cm. square and located opposite the midportion of the coronal sulcus; but in some of the experiments it was found to be slightly more anteriorly placed. These five excitable areas are indicated in Figures 17 and 18; and, in addition, there is indicated a sixth area, which though not responding to electrical stimulation, is of sufficient importance because of its architecture to be included in this study. Hereafter, I shall refer to areas from 1 to 6 without reference to Figures 17 and 18.

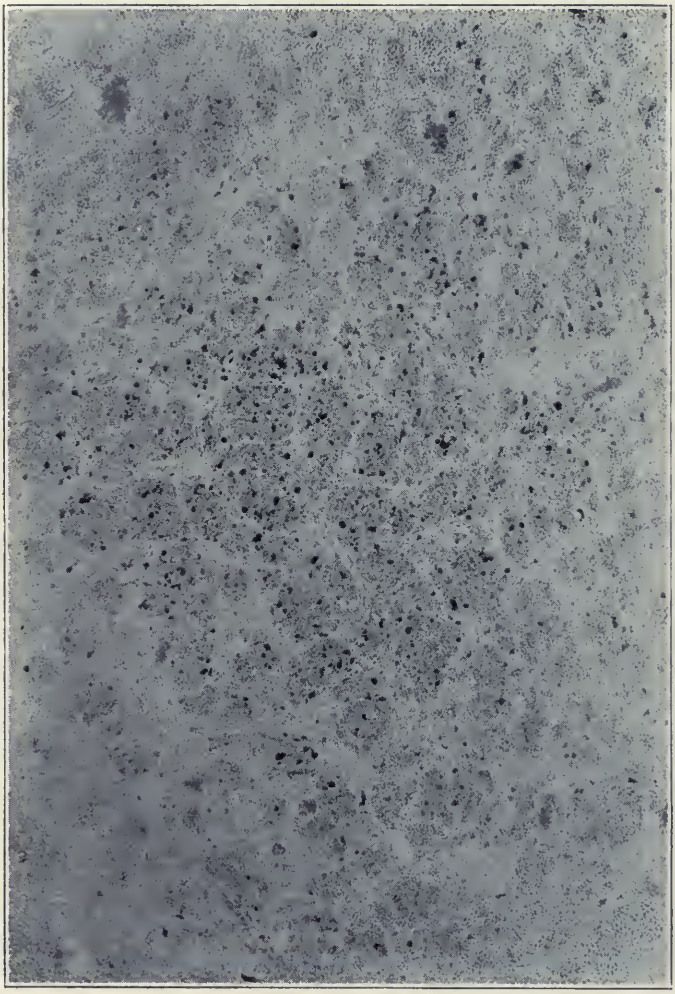

Fig. 23.—Photomicrograph showing the degeneration at *B* in Figure 21; × 125.

Stimulation of Areas 1 and 2 gave reactions in the extremities and occasionally in the trunk. Repeated efforts were made in both hemispheres to determine the individual areas for the four extremities; with very few exceptions the reaction occurred in more than one limb and, unless the current was kept at the minimum, a reaction occurred in all four extremities. When the current was reduced sufficiently so that only one or two limbs responded, although we can state no definite rule as to contralateral or ipsilateral reactions, since both occurred with almost equal frequency, we obtained many times movements of the opposite hind limb and the fore limb of the same side. Because of this association in the movements of the hind limb of one side and the fore limb of the other side, an attempt was made to determine the character of the movements as concerned progression. In most cases, however, the movements consisted of contraction of muscles of a single group, so that typical progressive movements could not be brought out. One can, however, say with certainty that the movement of two or more limbs did not occur with definite rhythm. In summing up all of the experiments on Area 1 there was a greater number of reactions in the hind legs and a greater number in the hind leg of the opposite side. In Area 2 there was a greater number

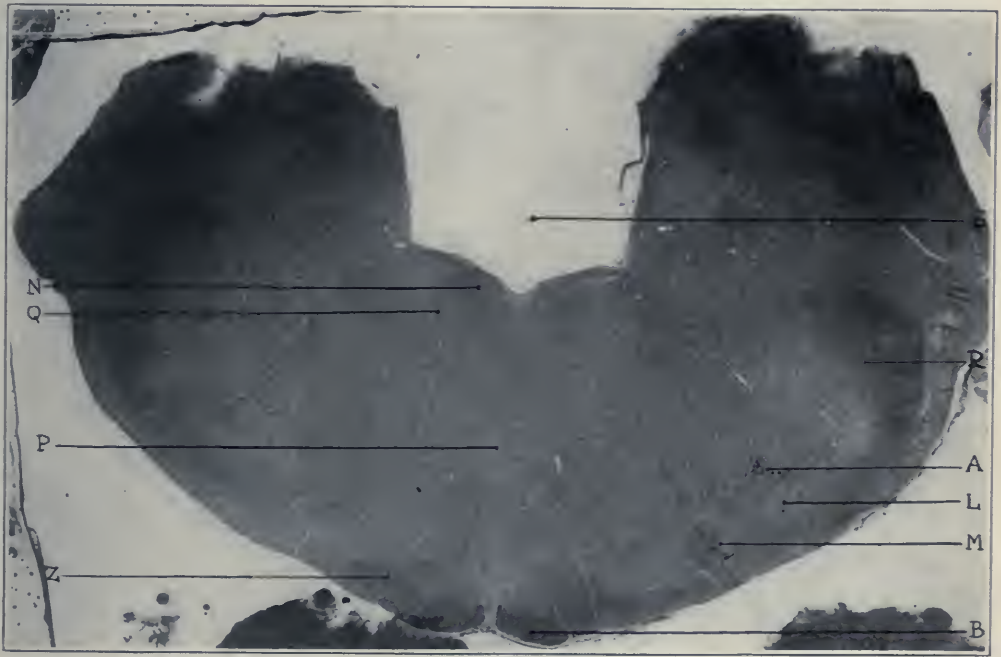

Fig. 24.—Marking the caudal end of the degeneration of the corticotegmental tract *A* at the position of the facial nucleus: *B*, pyramidal tract; *L*, facial nucleus; *M*, superior olive; *N*, posterior longitudinal bundle; *P*, colliculospinal bundle; *Q*, abducens nucleus; *R*, spinal root of trigeminal nerve; *S*, hind brain ventricle, and *Z*, mesial fillet; × 8.

of reactions in the fore limbs and the reactions of the limb of the opposite side were slightly greater. In addition to the limb movements, some movements of the trunk were observed but these were not conspicuous. In some experiments, Areas 1 and 2 gave movements of the head and eyes to the opposite side, but this was certainly the exception.

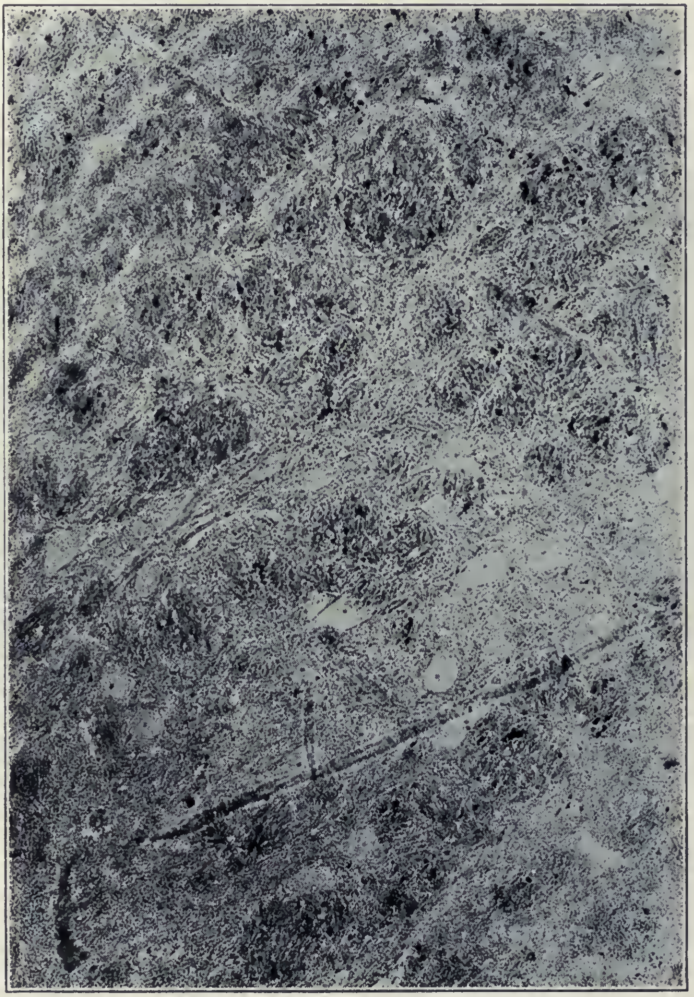

Fig. 25.—Photomicrograph taken from *A* in Figure 24, showing large cells of the facial nucleus among which are degenerated fibers of the corticotegmental bundle; × 125.

In Area 3 the movements of the head and eyes to the opposite side were always easily demonstrated and with few exceptions were the only reactions which occurred after stimulation of this area.

Stimulation of Area 4 produced contractions of the muscles of the opposite side of the face and the contractions were usually more marked in the lower lip. This result was usually easily obtained and with less current than was required to bring about reactions in the limbs in Areas 1 and 2; in some experiments, however, it was difficult to bring out, and in these animals it was also impossible to get the characteristic contractions of the opposite face muscles in any of the surrounding cortex. The reaction following stimulation of this area, however, was in the contralateral face muscles only, unless the current was sufficiently strong to spread to the ipsolateral face area (Area 5) across the coronal sulcus.

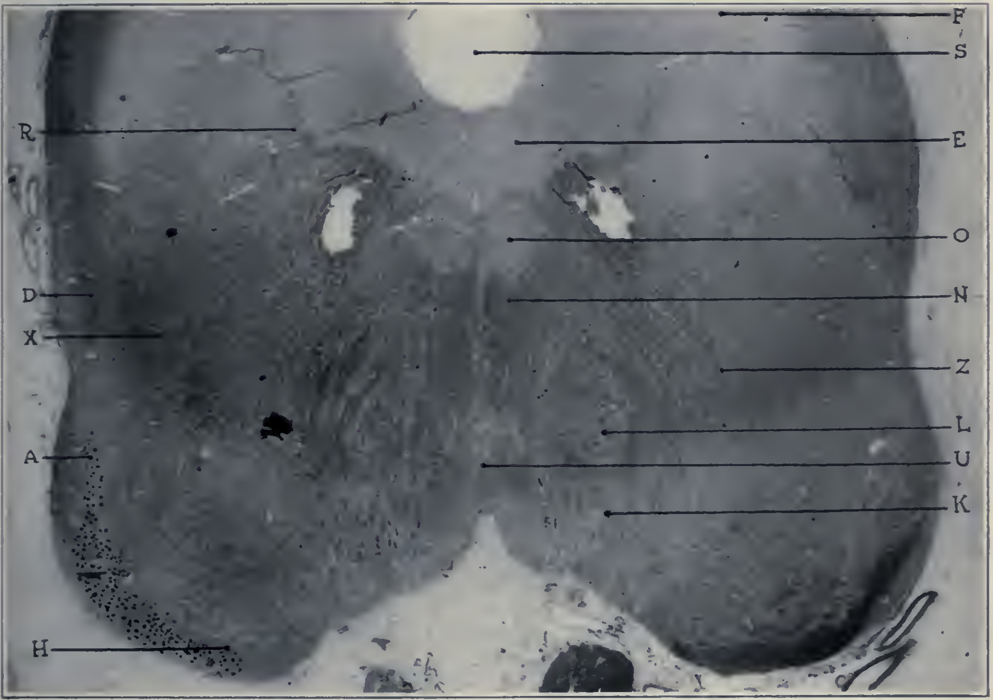

Fig. 26.—Degeneration in the crus after extirpation of Area 6. The very slight degeneration *A* extending toward the tegmentum, and its extreme lateral position as compared with the degeneration in Figure 20 may be noted: *D*, bracchium posticum; *E*, central gray; *F*, superior colliculus; *H*, cerebral peduncle; *K*, oculomotor nerve; *L*, nucleus ruber; *N*, posterior longitudinal bundle; *O*, oculomotor nucleus; *R*, mesencephalic root of trigeminal nerve; *S*. midbrain ventricle; *U*, Forel's decussation; *X*, superior mesial fillet, and *Z*, mesial fillet; × 8.

Stimulation of Area 5 gave ipsolateral contractions of the face muscles and the reactions were usually more marked in the upper lip. This result was constantly obtained in this area and characteristic reactions were in almost every case produced with a current less strong than that necessary to produce reactions in the other areas.

During the course of the experiments the entire dorsal and lateral surfaces of both cerebral hemispheres were repeatedly stimulated without noticeable muscle contractions in the periphery. The portions of the cortex just posterior to the cruciate sulcus and that surrounding the outer extremity of this sulcus were very carefully searched for even small points of excitability, but always without positive results. One special experiment was performed in an effort to determine the excitability of the gyrus (Area 6) surrounding the outer extremity of the cruciate sulcus. In this animal the five excitable areas responded to a current ranging from twelve to ten; but there was no response in this cortex (Area 6) at a current of eight, beyond which it was useless to go because of the probability of spread. In this animal the gyrus was extirpated and a very definite pyramidal tract degeneration was demonstrated in Marchi preparations (Fig. 28).

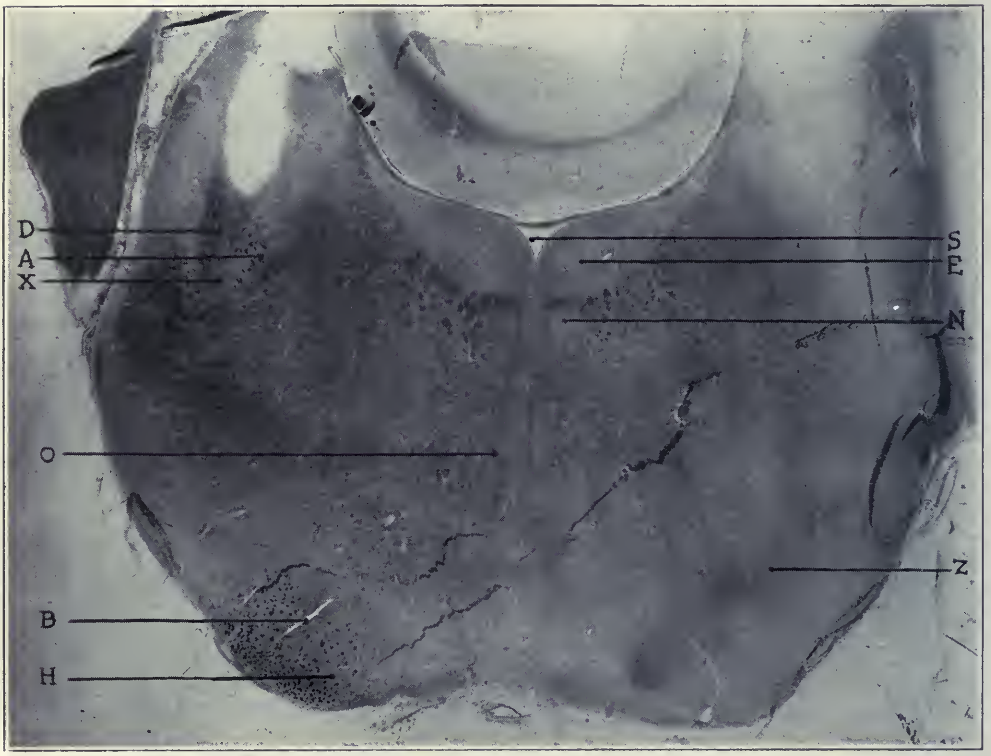

Fig. 27.—Caudal end of the cortico-tegmental tract degeneration *A,* after extirpation of Area 6; *B,* degeneration in pyramid; *D,* superior cerebellar arm; *E,* central gray; *H,* peduncle; *N,* posterior longitudinal bundle; *O,* colliculospinal bundle; *S,* ventricle; *X,* lateral fillet, and *Z,* mesial fillet; × 8.

The variation in the conclusions of previous workers is evidence of the difficulty encountered in attempting to establish definite areas of excitable cortex in the sheep brain. Our conclusions, which led to the outlining of five excitable areas, as indicated in Figures 17 and 18, were possible only after frequently repeated attempts. With a view to avoiding the possibility of misinterpretation some of the protocols are given below. Areas 1 to 5 indicate the areas as shown in Figures 17 and 18. The numerals before each result indicate the position of the coil on the centimeter scale of the Petzold apparatus, at which the reading was made. The stimulations were always commenced with a very weak current and a record made at a point where the current was sufficiently strong to cause a reaction. As will be found in the protocols, an effort was always made to determine the weakest current at which a given reaction could be obtained. In some experiments all areas of both hemispheres were stimulated; in others all areas of one hemisphere, while some experiments were devoted to the consideration of a limited number of areas of the cortex of one hemisphere.

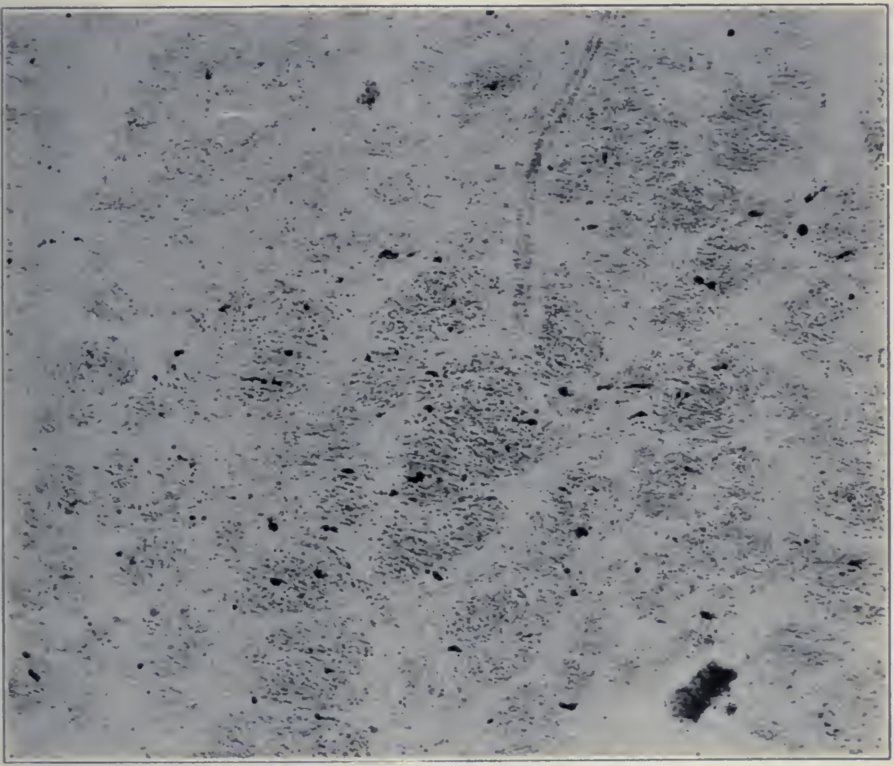

Fig. 28.—Photomicrograph showing the slight evidence of degeneration in the corticotegmental bundle after extirpation of Area 6, taken from *A* in Figure 27; × 125.

TABLE 1.—Results of Experiment 4 *

Right Hemisphere

Area 1	Area 2	Area 3	Area 5
12.5—R.F., L.H. and L.F., slight movement; all lifting and toe spreading	12.5—L.F., slight movement; R.H. and R.F., constant on repeated trial	12—R.F. and L.F., forward; R.H.. back and upward (delayed); L.H., back and upward (delayed)	11.5—Both lips to right, lower more markedly
12—L.H., R.F. and L.F., delayed; all three with toe spreading	12—R.H., L.H. and R.F., slight; L.F., very slight	11.5—Head pulls to left; R.F., strong; R.H. and L.F., slight 11.5—R.F. and L.F., forward; R.H., back and upward (delayed); L.H., back and upward (delayed)	10—Upper lip puckered. indefinite 10—Right upper lip elevated 10—Nose and upper lip to right
	11.5—R.H., pulled forward; R.F., pulled forward; L.F., one half as much as R.F.; L.H., very slight	10—L.H., extension followed by flexion; L.F., extension forward; R.F., forward, but slighter	
Left Hemisphere			
10—R.H., slight extension; L.F., extension, more slight	10.5—Head pulls back to right	11—Head to right; R.H., up; R.F., up and forward; stronger current brings in both sides	
9.5—R.H. and L.F., slight extension	10—Head pulls back to right; R.H. and L.F., up; R.F., up slightly 10—R.H., forward; R.F., forward (delayed); L.F., very slight	10—R.H., up; R.F., up and forward	
	9.5—Head pulls back; L.H., forward; R.H., forward stronger; R.F., forward 9.5—L.F. and R.H., forward; L.H. and R.F., delayed	9.5—Head rotates to right strongly; R.F., back and outward	
	9—Head pulls back; R.H., R.F. and L.F., forward —R.H., forward and up; L.F., backward —R.H., L.H. and R.F., forward and up; L.F., backward	9—Head rotates to right strongly; R.F., back and outward	

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* In this and the following table, R.F. indicates right fore leg; R.H., right hind leg; L.F., left fore leg, and L.H., left hind leg.

TABLE 2.—RESULTS OF EXPERIMENTS 11, 12, 13, 14, 15*

Right Hemisphere

Area 1	Area 2	Area 3	Area 4	Area 5
9.5—Outer extremity of the area: L.F., slight flexion	9.5—Outer extremity of the area: L.H., adduction slighter than right; R.H., adduction; L.F., flexion, slighter than in Area 1; R.F., toe spreading, definite slow turning movements of head and eyes to left (found only on the surface of the area)	10—Same as in Area 2 except that movements are more pronounced; tail wiggles, spasms of face muscles, chewing motion again brought out at this point, apparently due to long continued stimulation; definite head and eyes to left	9.5—Firm contraction of left face muscles with rotation of head to left	10+Usual homolateral face movements
10—No response	10—R.H., pulling outward and backward, distinct, very marked; L.F., stiffening and pulling backward, very slight; R.F., toe spreading, very slight; pulling backward of head and eyes to left 10—Definite, head and eyes to left	10.5—L.H., flexion; L.F., strong extension and toe spreading; R.F., slight extension of knee with toe spreading, followed by marked flexion of knee and shoulder; tail wiggles; also grinding of mouth; head and eye movements to left; quick spasm of right face muscles	9, 9.5,10, 10 5—No response	11—More definite movement of upper lip with some pulling of nostril to right
11—Outer extremity of area: drawing back of head 11.—L.F., flexion at knee and shoulder; lifting and pawing; inner extremity of the area: L.H., raising or pulling up	11—R.H., pulling outward and backward; drawing back of head (more pronounced than in Area 1); drawing of head to left, without eye movements 11—L.H., slight adduction; R.H., slightly raised and pulled forward; L.F., abducted forward; R.F., slight adduction and stiffening 11—L.H., forward slightly abducted; R.F., definite slight abduction	11—Definite drawing of head and eyes to left	10—Head and eyes to left (head and eye movements seem to extend over what is ordinarily Areas 3 and 4, about 14 mm.)	12—Slight definite contraction of muscles of upper lip on both sides
12—Outer extremity of the area: L.F., flexion at knee and shoulder; lifting and pawing	12—L.H., slight adduction; R.H., slightly raised and pulled forward; R.F., slight abduction and stiffening; L.F., forward and slightly abducted; R.H., pulled forward; R.F., definite slight abduction 12—L.F., occasional extension (followed by facial spasm, a violent struggling motion without chewing); head and eyes to left 12.25—R.H., very slight abduction; R.F., very slight pulling forward	9.5—Head and eyes to left	10.5—Definite contraction of muscles of left side of face with only very slight pulling of head to left	

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* These five experiments were performed on one animal, which gave results somewhat at variance with our other results, illustrating what is believed to be a marked individual variation in the reaction of the cortex.

TABLE 2.—RESULTS OF EXPERIMENTS 11, 12, 13, 14, 15 (*Continued*)

Left Hemisphere

8.5—L.H., pulling out and forward; R.H., raising; L.F., toe spreading; R.F., raising	7.5—On the dorsal surface at the mesial side of the area: pulling of head and eyes to right; on the lateral surface of the area: L.H., pulling forward, less active than R.H.; L.F., late toe spreading and extension of toes; R.F., toe spreading after flexion, stronger than L.F.	7.5, 8.5—L.H., pulling out and slightly forward; L.F., late toe spreading and extension of toes; R.H., stepping downward; R.F., turning downward and forward of hoofs; movement of whole pelvis to right	9—Rotation of head with elevation of nose, with slight contraction of right face, followed by strong contraction of left face	9.5—Elevation of angle of left upper lip and left lower lip
8, 9, 9.5, 10, 10.5, 11.5, 12—No response	8.5—L.H., lifting upward; R.H., extension; L.F., slight extension; R.F., flexion and extension	9, 9.5—No response	10.5—Quick response with grinding of teeth and pulling of jaw to left; definite rotation of head with marked contraction of face muscles of opposite side	10—Homolateral face (followed by active chewing and muscle spasms on both sides, so further stimulation was impossible)
12.25—On the outer extremity of the area: L.H., abduction and flexion of the whole limb markedly; R.F., pulling up of entire limb (repeated several times); on the inner extremity of the area: no response	9—Very quick response of head and eyes to right	10—Head and eyes to right	9, 9.5, 10.5—Rotation of head with elevation of nose to right without contraction of face muscles	10.5—Homolateral face
14.—L.H., same as at 12.25, but very slightly; R.F., same, but diminished	9.5—Very quick response of head and eyes to right	10.5—Pulling of pelvis to right, shoulder to left; no leg movements	10—Chewing motion with quick contraction of left lower lip; also contraction of muscles at both sides of nose	11.5—Stimulation of Areas 4 and 5 caused violent contraction of both sides of face indicating spread from homolateral to contralateral face area and vice versa
14.5, 15, 15.5, 16, 16.5—Same response as with stronger current	10—Head and eyes to right; R.H., slight forward movement; R.F., slight pulling forward	11, 11.5—No response	11.5—Stimulation of Areas 4 and 5 caused violent contraction of both sides of face, indicating spread from homolateral to contralateral area and vice versa	10, 10.5—Elevation of angle of left upper lip
	10, 10.5—L.H., mild pulling up; R.H., extension and pulling forward; R.F., slight abduction and toe spreading; head and eyes to right sharply	11.5—Head and eyes to right	11, 12—No response	11, 10.5, 9.5, 9, 12—No response
	11.5—On the dorsal surface at the mesial surface of the area: head and eyes to right	12—Head and eyes to right 12—No response		
	12—Definite slow movement of head and eyes to right; on the dorsal surface on the mesial side; no response			
	11—On the dorsal surface at the mesial side of the area: head and eyes to right			

TABLE 3.—Results of Experiments 16 and 17

Right Hemisphere

Area 1	Area 2	Area 3	Area 4	Area 5
9—L.F., constant flexion is not obtained	9—R.H., pushing backward; L.F., sharp pulling up; R.F., adduction; when repeated, only L.F. sharp raising	10—Head and eyes to left	9—Strong contraction of muscles of face on the left side	9—Strong contraction of muscles of right face
10.5—On the outer extremity of the area: L.F., flexion is not constant	10—L.F., pulled forward actively; R.F., pulled forward slightly; R.H., pulled forward (in the anterior portion of this area there is definite trunk movement with extension of L.F.)	11—Head and eyes to left	10.—Contraction of muscles of left side of face	10—Contraction of muscles of right face
		11.5—No response		
		Left Hemisphere		
9.5—No response	10—Same as at 10.5, but not constant	10—Head and eyes to right	10—Strong contraction of muscles of right side of face	10—Contraction of muscles of left side of face
	10.5—Toward the mesial aspect of the area: L.H., lifting and moving slightly forward; L.F., slight extension forward; R.F., slight extension forward, less in extent; all responses not constant 10.5—Toward the outer side of the area: R.F., brisk lifting			
	9.5—L.H., slight abduction; L.F., slight pulling forward; R.F., brisk lifting			

TABLE 4.—Results of Experiment 23

Right Hemisphere

Area 1	Area 2	Area 3	Area 4	Area 5
10.5—L.F., abduction and flexion; stronger current brings out movements of all four legs, particularly L.F.	10.5—Strong current brings out movements of all four legs, particularly L.F.; R.F., slight knee lifting	10—Head and eyes to left	9—Characteristic face reaction, chiefly of lower lip of opposite sides	10—Contraction of muscles of right face about 1 cm. further along coronal sulcus than usually found
11.—L.F., abduction and flexion; R.F., slight, which comes in late with slight flexion; stronger current brings out movements of all four legs, particularly L.F.	11—Stronger current brings out movements of all four legs, particularly L.F.	10.5—Head and eyes to left	10—Contralateral face reaction	10.5—Contraction of muscles of right face about 1 cm. further forward along coronal sulcus than usually found
	13—L.F., toe spreading and slight abduction; L.H., toe spreading and pulling forward; R.F., slight knee raising			

TABLE 5.—RESULTS OF EXPERIMENT 30

Area 1	Area 2	Area 3	Area 4	Area 5
Right Hemisphere				
(Not tested)	(Not tested)	11.5—Head and eyes to left	12—Definite puckering movements of both right and left sides (more marked on right) involving both upper and lower lips; if stimulation is continued there is licking of lips with tongue 13—Definite right upper lip	11—More marked reaction, same as at 12; fibrillary twitching occurs when contact is slightly prolonged 10—Definite chewing movements not defensive, but ceasing with removal of electrode; no saliva flow; repeatedly obtained in right hemisphere 12—Slight quick movement of right upper lip, elevation coinciding exactly with contact of electrode 13—Definite right upper lip, which is obtained only at knee of sulcus
Left Hemisphere				
11.5—R.H., predominating; L.H., and L.F., slight; R.H. and R.F., slight when repeated	11.5—L.H., predominating; R.H., comes in with L.F.; L.H., alone when repeated †	12.5—Head and eyes to left	10—Very definite contralateral twitching of lower and upper lips, chiefly lower 11.5—Very active upper lip and fairly well marked lower lip on both sides, right stronger 13—No response; this includes everything of both sides of sulcus one	13—Definite retraction and elevation of left upper lip (at knee of sulcus for a very limited area)

† Cortex just posterior to cruciate sulcus gave no response. Small U shaped gyrus surrounding outer extremity of cruciate, no response.

EXTIRPATION EXPERIMENTS

In the extirpation experiments, stimulation Areas 1, 2 and 3, as previously described, were extirpated en masse. Stimulation Areas 4 and 5 were extirpated separately. The small U-shaped gyrus surrounding the outer extremity of the cruciate sulcus (Area 6), which contained very large pyramidal cells but gave no reactions when stimulated, was also extirpated separately. In the Marchi sections, after extirpation of all of these areas, a degeneration could be followed through the corona radiata, into the internal capsule, the peduncle, the pyramidal tract and after decussation, to the upper cervical segments of the spinal cord. In addition there was always a degeneration shown by very much smaller dots extending through the corpus callosum and in almost all instances to the same gyri of the opposite side.

The study of the main mass of the pyramidal tract after extirpation of various areas of the cortex revealed findings similar to those previously described by Dexler and Margulies[5] and by King.[6] Examination of the Marchi preparations of frontal sections made at a high level of the crus revealed variations in the position of the degenerated fibers in the crus following extirpation of the different areas.

After extirpation of stimulation Areas 1, 2 and 3 in the superior frontal gyrus, the degeneration involved chiefly the middle portion of the pes, there being no degeneration dots in the most mesial and most lateral bundles. The dots were very numerous, rather compact and varied in size from very minute to rather large ones. After extirpation of stimulation Area 4, the degeneration was very generally scattered over the structure, involving all except a very small area on the mesial side and a little larger area on the lateral side. The dots were much fewer in number and smaller than those observed in sections after extirpation of Areas 1, 2 and 3. After extirpation of stimulation Area 5 in the middle frontal gyrus, the degeneration involved chiefly the mesial portion of the pes, there being no dots in the position of the outermost fibers of the structure. There were practically no dots in the area as large as those seen after extirpation of the superior frontal gyrus, so that when the dots were compared they ranged from small to medium size and were widely scattered. After extirpation of the small U-shaped gyrus surrounding the outer end of the cruciate sulcus (Area 6), the preparations showed rather small dots scattered chiefly through the central portion of the pes, extending toward, but not involving, the extreme lateral bundles and entirely missing the mesial bundles.

In frontal sections made at the level of the nucleus ruber, there was evidence, after extirpation of the various areas, of degenerated fibers migrating dorsalward from the peduncle into the tegmentum (Fig. 19). Ater extirpation of stimulation Areas 1, 2, 3 and stimulation Areas 4 and 5, there was very little difference in the amount of degeneration extending into the tegmentum, so that Figure 20, made after extirpation of stimulation Area 5 in Figures 17 and 18, is a good representation of this degeneration after extirpation of the three areas. In the sections slightly more caudal than those just described, the degenerated tegmental fibers are separated from the main mass of the pyramidal tract, forming an almost circular area as shown diagramatically at *B* in Figure 21 and microscopically in Figure 23. These figures were made after extirpation of Areas 1, 2 and 3; but they also represent the appearance of the tegmental bundle degeneration after extirpation of Areas 4 and 5. The degenerated dots are more numerous, larger and more closely compact in the main mass (Fig. 22) of the pyramidal tract than in the tegmental bundle mass (Fig. 23). The tegmental bundle degeneration is easily followed until the section at the level of the facial nucleus is reached (Fig. 24), while beyond this point it cannot be demonstrated. At this level the degenerated fibers can be found among and surrounding the cells of the facial nucleus (Fig. 25).

After extirpation of Area 6 in the section at the level of the nucleus ruber, the tegmental degeneration was very slight and the fibers were seen in a much more lateral position (Fig. 26). The degeneration does not extend to so low a level in the brain stem as it does after extirpation of the other areas, and was last visible in the sections represented by Figure 27, a microscopic picture of which is shown in Figure 28.

CONCLUSIONS

1. The coronal sulcus is one of the first fissures to appear in the development of the neopallium in the sheep embryo. Lamination of the cortex mesial and lateral to the coronal sulcus is well marked at a stage of development when the coronal sulcus has all the characteristics of the sulcus of the adult sheep brain. At this stage the layer of large pyramidal cells extends throughout the "superior frontal convolution" and through the mesial portion, but does not reach the crest of the "middle frontal" convolution.

2. Our histologic findings in the superior frontal convolution are the same as those described by King; and in addition the cortex of the "middle frontal" convolution and that surrounding the outer extremity of the cruciate sulcus also present somewhat the same appearance.

3. Stimulation of the posterior portion of the superior frontal gyrus produces contractions of the extremities. The cortex of the gyrus immediately in front of this area when stimulated causes movements of the head and eyes to the opposite side. Stimulation of the most anterior portion of the superior frontal gyrus gives no reaction.

Stimulation of the small gyrus (Area 4) lying between the frontal end of the presylvian fissure and the outer anterior spur of the coronal sulcus causes contraction of the *face muscles of the opposite side,* more particularly of the lower lip.

Stimulation of the "middle frontal" gyrus over an area about 1 cm. square usually opposite the middle portion of the coronal sulcus, but sometimes slightly more anterior, causes contraction of the *muscles of the face of the same side.* This center is easily excited, usually requiring less current than is necessary in the other areas.

Stimulation of the gyrus surrounding the outer extremity of the cruciate sulcus produces no reaction, notwithstanding its "motor" pattern.

There is no response to stimulation of areas posterior to the cruciate sulcus.

4. After extirpation of the excitable areas of the cortex, we agree with previous workers that there is no disturbance of locomotion. We further agree with the findings of other workers concerning the course of the main mass of the pyramidal tract, its decussation in the hindbrain, and disappearance in the upper cervical segments of the spinal cord.

In addition to the main mass of pyramidal tract degeneration, there is, however, in the tegmentum, evidence of the degeneration of a bundle of fibers. This degeneration, ipsolateral in its entire course, is first noticed in frontal sections at the level of the nucleus ruber, where the degeneration is followed dorsalward from the pyramidal tract to the dorsolateral angle of the tegmentum, ending at the level of the facial nucleus, beyond which point we cannot demonstrate it. No decussation to the extralateral nucleus was noted.

ADDITIONAL BIBLIOGRAPHY

Ariens Kappers, C. U.: Cerebral Localization and the Significance of Sulci; A Report Dedicated to the Memory of D. J. Cunningham and E. Zuckerkandl, Tr. Internat. Cong. Med. 1913, London, 1914, Sect. I, Anatomy & Embryology, Pt. 2, pp. 273-392.

Bolton, J. S.: The Brain in Health and Disease, New York, Longmans, Green & Co., 1914; London, E. Arnold.

Brodmann, K.: Vergleichende Lokalisationslehre der Grosshirnrinde, Leipzig, J. A. Barth, 1909.

Brown, T. G.: Studies in the Physiology of the Nervous System. VII: Movements Under Narcosis in the Pigeon; Movements Under Narcosis in the Rabbit; Progression; Scratching; Flexion, Quart. J. Exper. Physiol. **4**:151-182, 1911.

Brown, T. G.: The Factors in Rhythmic Activity of the Nervous System, Proc. Roy. Soc., London **85**:278-289, 1912.

Brown, T. G.: Studies in the Physiology of the Nervous System. XX: Rythmic Movements as Immediate Reflex Phenomena of Compound Stimulation (Progression Conditioned by Antagonistic Reflex Stimuli), Quart. J. Exper. Physiol. **8**:155-191, 1915.

Brown, T. G.: Studies in the Physiology of the Nervous System. XXII: On the Phenomenon of Facilitation. 1: Its Occurrence in Reactions Induced by Stimulation of the "Motor" Cortex of the Cerebrum in Monkeys, Quart. J. Exper. Physiol. **9**:81-99, 1916.

Burkholder, J. F.: The Anatomy of the Brain, Chicago, G. P. Engelhard & Co., 1912.

Campbell, A. W.: Histological Studies on the Localization of Cerebral Function, Cambridge, University Press, 1905.

Dusser de Barenne, J. G.: Experimental Researches on Sensory Localizations in the Cerebral Cortex, Quart. J. Exper. Physiol. **9**:355-390, 1916.

Flatau, E., and Jacobsohn, L.: Handbuch der Anatomie und Vergleichenden Anatomie des Centralnervensystems der Säugetiere, Berlin, S. Karger, 1899.

Forbes, A.: Reflex Rhythm Induced by Concurrent Excitation and Inhibition, Proc. Roy. Soc., London **85**:289-298, 1912.

Fortuyn, A. B. D.: Cortical Cell-Lamination of the Hemispheres of Some Rodents, Arch. Neurol & Psychiat. **6**:221-354, 1914.

Gans, A.: Die Pyramidenbahn der Phocaena, Anat. Anz. **49**:281-284, 1916-1917.

Gierlich, N.: Zur vergleichenden Anatomie der aus dem Grosshirn stammenden Faserung. 3. Der Anteil des Cerebellum sowie der motorischen Kernlager des Hirnstammes und des Rückenmarks an dem Pes pedunculi bei Phocaena und Delphinus delphis, Anat. Anz. **49**:285-288, 1916-1917.

Hermanides, S. R., and Köppen, M.: Ueber die Furchen und über den Bau der Grosshirnrinde bei den Lissencephalen insbes. über die Localisation des motorischen Centrums und der Sehregion, Arch. f. Psychiat. **37**:616-634, 1903.

Köppen, M., and Loewenstein, S.: Studien über den Zellenbau der Grosshirnrinde bei den Ungulaten und Carnivoren und über die Bedeutung einiger Furchen, Monatschr. f. Psychiat. u. Neurol. **18**:481-509, 1905.

Lewis, B.: On the Comparative Structure of the Cortex Cerebri, Brain **1**: 79-96, 1878.

Mellus, E. L.: Preliminary Note on Bilateral Degeneration in the Spinal Cord of Monkeys Following Unilateral Lesion of the Cortex Cerebri, Proc. Roy. Soc. London **55**:208-210, 1894.

Mellus, E. L.: Bilateral Relations of the Cerebral Cortex, Bull. Johns Hopkins Hosp. **12**:108-112, 1901.

Rothmann, M.: Die Zerstörung der Pyramidenbahnen in der Kreuzung, Neurol. Centralbl. **19**:1055-1061, 1900.

Sabin, F. R.: On Flechsig's Investigations on the Brain, Bull. Johns Hopkins Hosp. **16**:45-49, 1905.

Sherrington, C. S.: Remarks on the Reflex Mechanism of the Step, Brain **33**:1-25, 1910-1911.

Sherrington, C. S.: Nervous Rhythm Arising from Rivalry of Antagonistic Reflexes: Reflex Stepping as Outcome of Double Reciprocal Innervation, Proc. Roy. Soc., London **86**:233-261, 1913.

Simpson, S.: The Pyramid Tract in the Striped Gopher (Spermophilus tridecemlineatus [Mitchell]), Quart. J. Exper. Physiol. **8**:383-390, 1915.

Starlinger, J.: Die Durchschneidung beider Pyramiden beim Hunde, Jahrb. f. Psychiat. u. Neurol. **15**:1-42, 1897.

Streeter, G. L.: The Development of the Nervous System in Man: Human Embryology, Philadelphia, Keibel & Mall **2**:1-156, 1912.

Van der Vloet: Ueber den Verlauf der Pyramidenbahn bei niederen Säugetieren, Anat. Anz. **29**:113-132, 1906.

Watson, G. A.: The Mammalian Cerebral Cortex, with Special Reference to Its Comparative Histology: 1. Order Insectivora, Arch. Neurol. **3**:49-117, 1907.

Weed, L. H.: Observations upon Decerebrate Rigidity, J. Physiol. **48**: 205-227, 1914.

Weed, L. H.: The Reactions of Kittens after Decerebration, Am. J. Physiol. **43**:131-157, 1917.

Ziehen, T.: Ueber die Pyramidenkreuzung des Schafes, Anat. Anz. **17**: 237-241, 1900.

DISCUSSION

Dr. Adolf Meyer of Baltimore said that he considered this a very interesting question. The fact remained, however, that Dr. Bagley in his experiments did not ever get any passing over of fibers of the pyramidal tract for the contralateral functions in the cranial segments. It was probable that the pyramidal fibers reached the segment and that perhaps in the intrasegmental working the determination took place as to which responses were going to come, the ipsolateral or the contralateral, although in the cerebral cortex there appear to be different regions from which these tendencies could be provoked.

PARALYSIS OF ASSOCIATED LATERAL MOVEMENTS OF THE EYES

A SYMPTOM OF INTRAPONTILE LESION *

WALTER FREEMAN, M.D.

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Now that the cranial cavity is being opened by surgeons with less and less reluctance, the differential diagnosis between a lesion within the brain substance and one on the surface becomes of increasing importance. Especially is this true of tumors of the posterior fossa, in which field have been made some of the most recent advances in the art of intracranial surgery. Cushing's book, "Tumors of the Nervus Acusticus" indicates what measure of success has been attained.

Since cerebellopontile angle tumors are accessible, and intrapontile tumors inaccessible, naturally the diagnosis between them should anticipate operation. Tumors of the angle by pressure can cause many of the paralyses, anesthesias and ataxias caused by intrapontile lesions. There is, however, one symptom very characteristic of a lesion within the pons that has not been successfully produced by an acoustic tumor. Though Frankl-Hochwart, Alexander, Cushing and Henschen have reported cases in which associated movements of the eyes were interfered with, there has been no case of tumor in the cerebellopontile angle causing clear-cut paralysis of associated lateral movements of the eyes with preservation of the convergence reaction of the internal recti. The following case will show the importance of recognition of the symptom.

REPORT OF A CASE

History.—On Dec. 16, 1917, Miss S. K., a white woman aged 59, was admitted to the service of Dr. Spiller at the Hospital of the University of Pennsylvania, complaining of dizziness and diplopia. For the last three and a half years she had not been well, being troubled at first by frontal headaches and attacks of vomiting. About two years ago a hissing sound developed in her left ear and a month later she noticed that she was deaf in that ear. She began to stagger while walking, and this became progressively worse until she had to stop work. In February, 1917, she noticed that the right side of her mouth drew up and that the left eye could not be closed completely. Vision at a distance was blurred and recently she had had diplopia. The left side of her face had become numb. She could chew well but she had difficulty in swallowing, and when attempting to drink fluids escaped from the corner of her mouth. The left side of her tongue became numb, and things did not taste the same on the two sides. In November her voice took on a quiver. There was no weakness of the limbs.

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* From the University Hospital.

She had had bronchial trouble at the age of 18 for about eighteen months and typhoid fever at the age of 38. Her social and family history were negative.

Physical Examination.—This revealed an emaciated woman of good mentality. The cranial vault was normal; neither drum head showed disease. Hearing was normal on the right; the left ear was deaf to air and bone conduction.

Face: The left brow muscles contracted poorly. The left eyelid could not be completely closed and showed fine fibrillary twitching.

Eyes: There was slight rough nystagmus on looking straight ahead and at times a slight outward squint for a few moments. Looking far to the right started slow horizontal nystagmus with the rapid component to the right. Looking to the left the rapid component was to the left. Looking upward caused nystagmus both vertical and rotatory, with the rapid component up. The pupils were equal and reacted normally to light and in accommodation. Vision was impaired in both eyes, more so on the left. Fundus examination showed only slight pallor of the nerve heads and slight diminution in the size of the arteries.

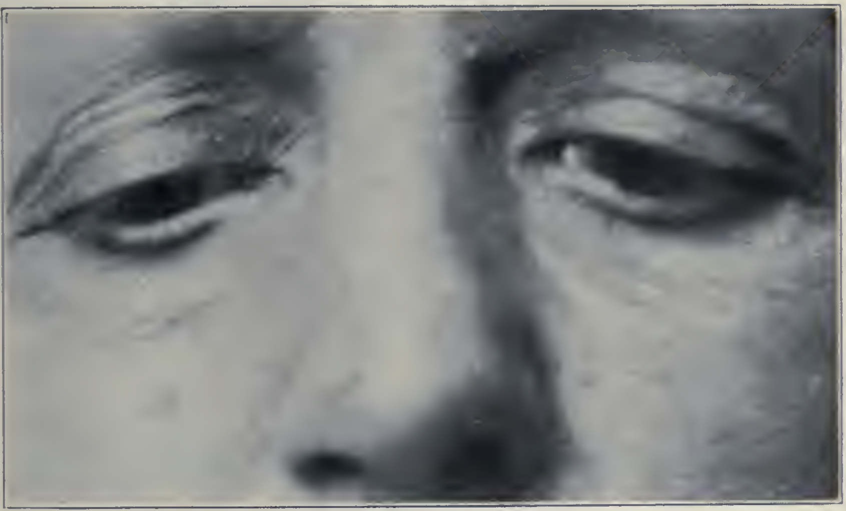

Fig. 1.—The convergence of the eyeballs when associated movement to the left was impossible.

Mouth: The left corner of the mouth could not be drawn up and attempts to whistle showed a flat left side. The tongue was protruded in the midline. Taste was normal for bitter, sour and sweet, but salt was miscalled on both sides. The gag reflex was diminished. The masseter did not contract as strongly on the left, and the jaw deviated to the left.

Chest: At the right apex there was harsh breathing with prolonged expiration. The heart was normal as were the abdomen and extremities.

Gait and Station: The gait was uncertain, not spastic. There was difficulty in standing with the eyes open, not increased by closing them. The hands had a coarse tremor.

Reflexes: Biceps and triceps reflexes and the knee and ankle reflexes were bilaterally overactive. There was patellar clonus on both sides and ankle clonus on the left. There was no Babinski sign or abdominal reflex.

There was a tendency to hypermetria; there was no adiadokokinesis. Stereognostic perception was good, sensation normal.

Blood, urine and cerebrospinal fluid were normal. The Wassermann reaction was negative.

Eye Report (May, 1918): There was a decided horizontal nystagmus, most marked in excursion to the right. The pupils were widely dilated (homatropin) the right more than the left. The right eye was normal. The left fundus was slightly hazy, probably due to slight changes in the corneal epithelium from exposure. There was paralysis of the left external rectus and of the left orbicularis palpebrarum. The corneal reflex was diminished on the left. Vision in the right eye was 6/12, in the left 6/15.

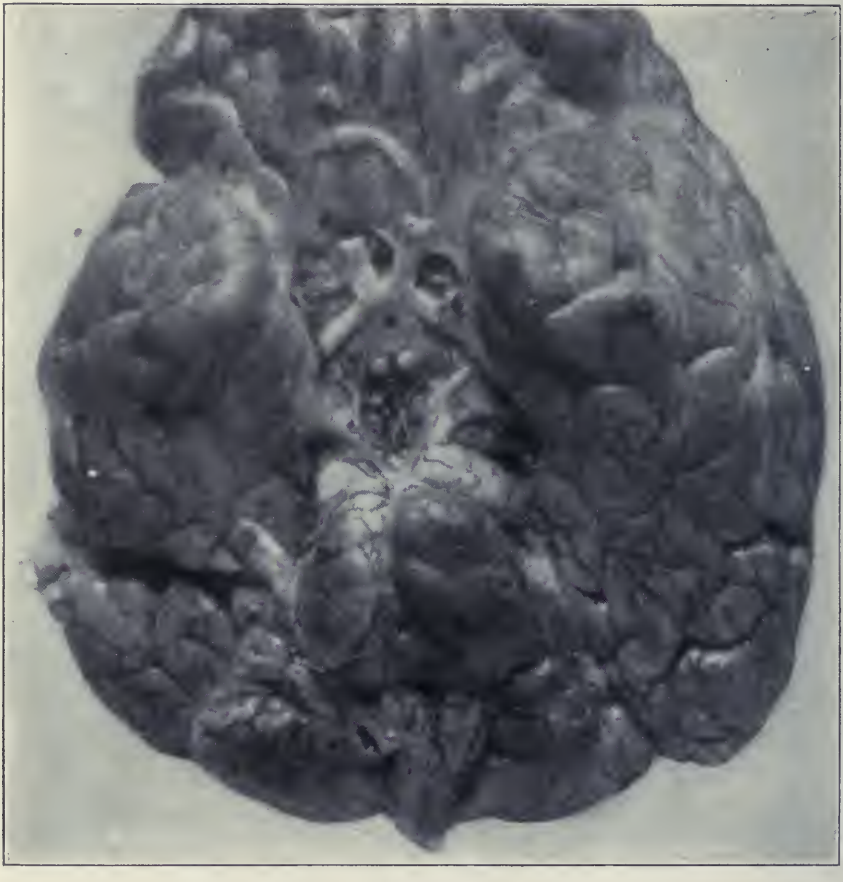

Fig. 2.—Base of brain showing glioma of pons.

Nose and Throat Report: Distinct anesthesia of the left side of the soft palate, base of the tongue and larynx was present. There was no actual paralysis of the palatine and laryngeal muscles, but they did not contract well.

Ear Report: There was almost complete nerve deafness on the left side.

Vestibular Report: There was spontaneous nystagmus as described in the foregoing. Turning to the right stopped the spontaneous nystagmus for ten seconds. Turning to the left increased the large existing nystagmus for twenty-five seconds. The douche gave no nystagmus on either side with the head straight. With the head back there was a marked reaction upward on douching the right ear with a tendency to conjugate deviation to the left. On douching the left ear, the head being thrown back, there was no reaction. Past-pointing was spontaneous to the left. This was little changed by rotation in the chair.

Course.—A diagnosis of tumor of the cerebellopontile angle was made and operation suggested. There was some hesitancy about operating until the condition of the patient was better. In the fall of 1919 exploration was decided on, when Dr. Spiller found paralysis of associated movements to the left with preservation of the power of convergence. Operation was immediately abandoned, it being certain that the lesion was intrapontile and inoperable. The symptoms steadily progressed, the patient grew gradually weaker, and died on May 6, 1920, having been bedridden for about two months. The day before death, though her mentality was greatly reduced, she still recognized people. The grip was fair and well coordinated; her speech was almost unintelligible. The paralysis of associated lateral movements to the left was unchanged and there was still slight power of convergence (Fig. 1).

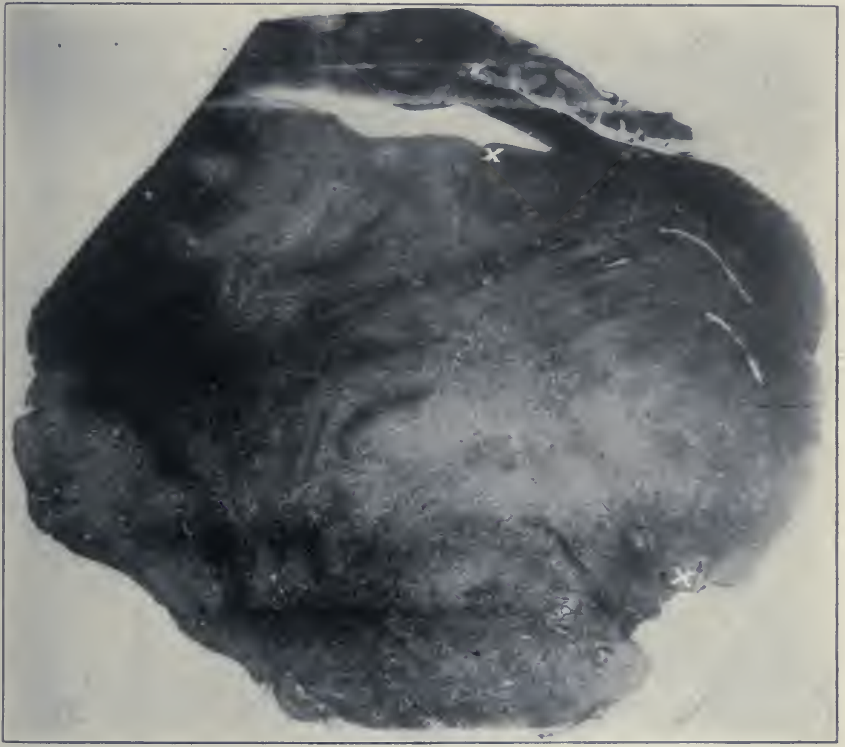

Fig. 3.—Section of pons showing glioma; *x*, raphé. The architecture of the pons has been almost completely destroyed by the tumor. In comparison note the well defined markings of the cerebellum.

Necropsy Examination.—This revealed a glioma of the pons which was much enlarged by the tumor (Fig. 2). Over the anterior surface of the left half there was a flattened mushroom growth extending into the left cerebellopontile angle, apparently not infiltrating the left cerebellar hemisphere. The right half of the pons was also infiltrated.

On sectioning the hardened brain-stem through the pons above the entrance of the fifth nerve, the left side was found much larger than the right, and the median raphé distorted (Fig. 3). The fourth ventricle was reduced to a narrow slit and nearly occluded at a higher level although there was no actual obstruction since the lateral ventricles were not dilated. The growth was located principally on the left side in the ventral portion, though it involved the right pyramid and also the dorsum of the pons and part of the floor of the left half of the fourth ventricle. It extended through the brachium conjunctivum into the left lobe of the cerebellum.

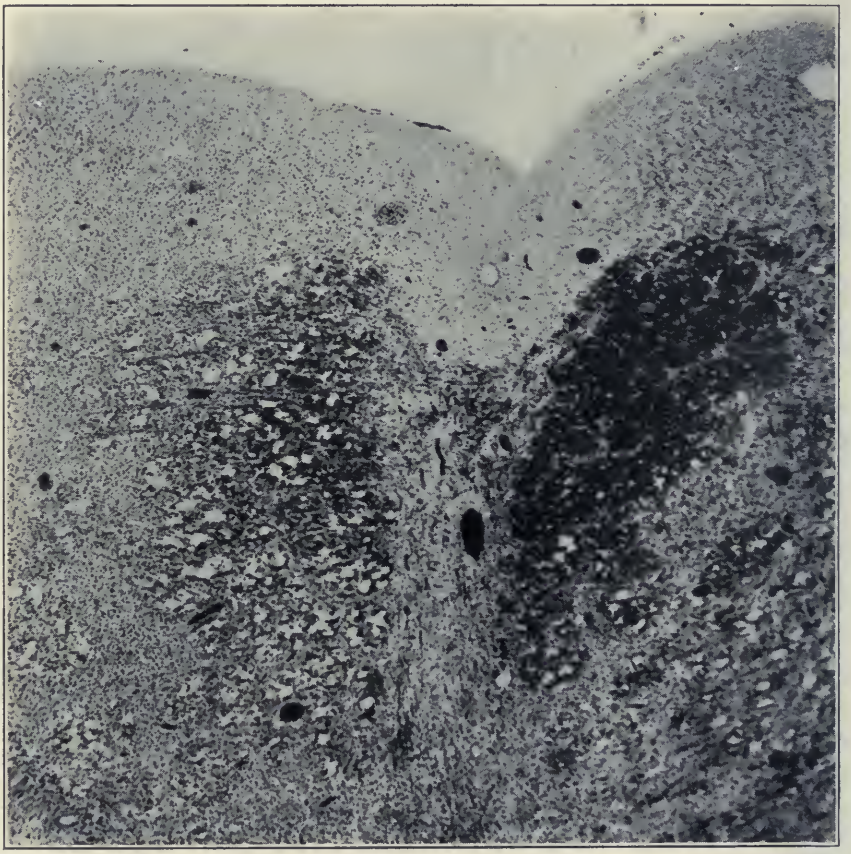

Fig. 4.—Photomicrograph of posterior longitudinal bundles showing marked degeneration on the left.

The centripetal fibers in the dorsum of the pons retained their myelin sheaths to a large extent, but the entire ventral portion of the pons was replaced by a diffuse infiltrating gliomatous growth that had destroyed the myelin sheaths. The tumor was cellular, most of the cells being spindle-shaped, with large vesicular nuclei staining deeply. Blood vessels were moderately numerous, with thin walls and large caliber. There was no distinct boundary to the growth, but a gradual transition from normal nervous substance to tumor tissue. A few myelin sheaths could be seen well within the boundaries of the tumor (Fig. 3).

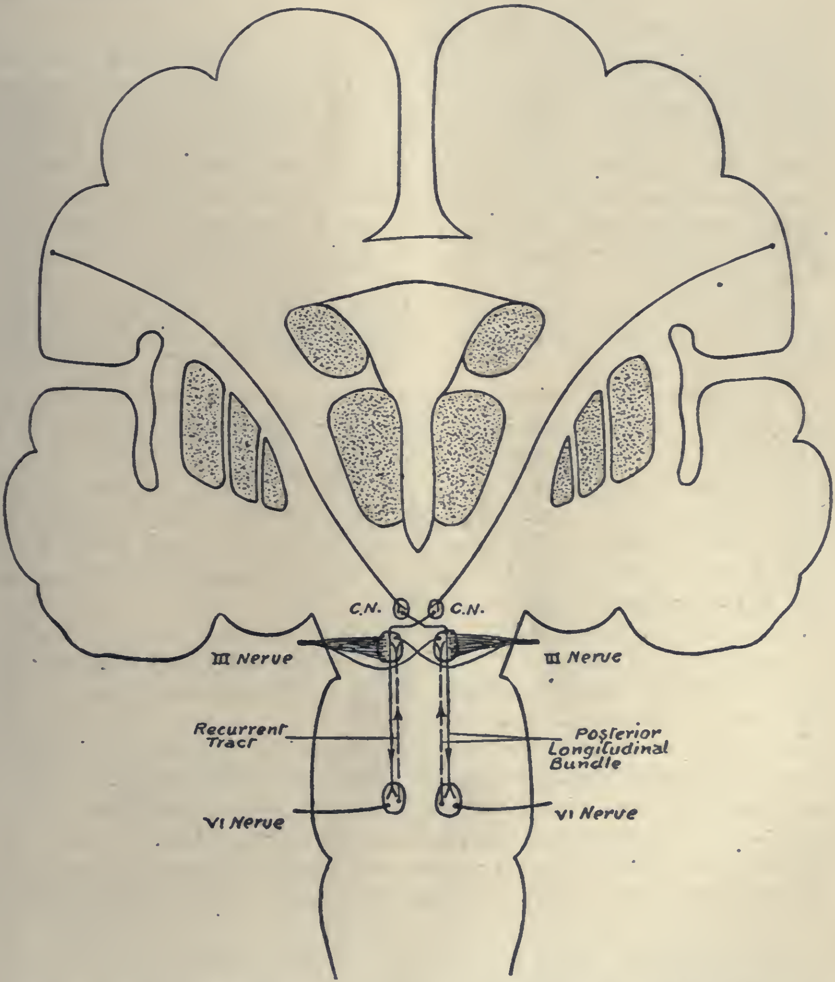

Fig. 5.—Tracts for lateral ocular movement; C. N., anterolateral nucleus of Darkschewitsch (modified from Piersol).

Of special interest was the posterior longitudinal bundle which could be seen with the naked eye to be smaller and paler on the left than on the right. In Weigert preparations, the left fasciculus, while not infiltrated by tumor cells at the level examined, was seen to be reduced in size, vacuolated, and replaced to a large extent by glia. The right fasciculus, while not entirely normal, showed much less advanced changes (Fig. 4).

The left sixth nerve was found to be smaller and paler and more translucent than the right one. The left seventh and eighth nerves showed the same degenerative changes.

Sections from the cords showed no visible degeneration of the tracts. The ventral horn cells contained no more than the physiologic amount of pigment. The pia was hyperplastic but not infiltrated.

SUMMARY

Notes on Condition, Jan. 22, 1920:

Chronology of Symptoms: For five and a half years there had been frontal headache and vomiting, and for four years hissing in the left ear and deafness. The patient staggered in walking. The left side of the face had been paralyzed for three years. She had diplopia two years ago. There was a reflux of water through the nose and dysphagia. Her voice quivered. She had dizziness and dimness of vision. A year and a half ago she became unable to stand and leaning forward caused vomiting. Two months ago there was paralysis of associated movement of the eyeballs to the left, with preservation of the power of convergence.

Positive Neurologic Findings: A. General Pressure: There was frontal headache and occasionally vomiting, sometimes projectile. Visual acuity was 6/22.3 in either eye.

B. Localizing: (1) Cerebellar: There was a history of "cerebellar attitude" and nystagmus, vertical, lateral and rotatory. Hypermetria was present.

(2) Extracerebellar: Cranial Nerves:

Fifth Nerve: There were slight subjective hypesthesia on the left and objective diminution of sensation in the left supra-orbital region; neuroparalytic keratitis; deviation of the jaw to the left; paralysis of temporal and masseter muscles with atrophy; insensitiveness of the palate and pharnyx. The right side was normal throughout.

Seventh Nerve: Complete left facial palsy was present.

Sixth Nerve: There was a history of diplopia and paralysis of the left external rectus. There was also recent paralysis of associated movements to the left, with preservation of convergence.

Eighth Nerve: There were nerve deafness on the left side with tinnitus; recent diminution of hearing on the right; greatly altered labyrinthine responses.

Ninth, Tenth and Eleventh Nerves: Dysphagia, dysarthria and ageusia were present on the left, and there was paresis of the right vocal cord.

(3) Spinal System: The deep reflexes were exaggerated, more so on the left, with ankle and patellar clonus on both sides and a Babinski sign on the left.

The feature of prime importance was the paralysis of associated movement for it rendered the thought of operation untenable. The symptom was striking. Barring nystagmus, the eyes could be moved normally to the right, upward and downward, but movements to the left of the midline were impossible. Yet the patient could converge to the physiologic limit, that is to say, the internal rectus of the right eye was paralyzed for associated movement to the left, but not for the same movement in convergence (Fig. 1). At rest both eyes were in the primary position.

The syndrome is known by various names in other languages; in French: "Paralysie des mouvements associés de lateralité des globes oculaires"; in German: "Seitliche Blicklähmung." The French sometimes term it "Syndrome de Foville."

The first mention of it in the literature was made by Foville in 1858, when he described a typical case, with paralysis of the left side of the face and right side of the body and paralysis of associated movement of the eyes to the left. Unfortunately necropsy examination was not made, but his name has been connected with the syndrome. Foville considered that there was paralysis of the right internal rectus, and it was Féréol who first pointed out that this was only a functional paralysis, and that there was preservation of the power of convergence. Necropsy examination in his case showed a tubercle in the dorsum of the pons on the left side. Féréol also noted that when the left eye was closed, the right eye could be moved freely in all directions and that it was only in associated movements that there was inability to look to the left. Many other investigators have since made contributions to the study of this syndrome.

THE HIGHER CENTERS

The movements of the eyes to the sides demand a fine coordinating mechanism for the continued maintenance of binocular vision. This mechanism consists of two parts, the voluntary or cortical centers, and the reflex or pontile centers. The locations and functions of each are:

Cortical.—Grünbaum and Sherrington, following Beevor and Horsley, found an area in the middle and inferior frontal convolutions, excitation of which caused conjugate deviation of the eyeballs to the opposite side. Sherrington [19] concluded that the taxis of muscles lying to the right of the median sagittal plane was entrusted to the left hemisphere, and *vice versa.* Associated movements of the eyes have also been obtained by stimulation of the occipital cortex and a visuomotor area has been postulated. Also, in the temporal lobe there is an area, stimulation of which causes conjugate movements of the eyes to the sides, the so-called auditomotor area.

Bernheimer [15] presents evidence that the gyrus angularis is an important center for associated movements of the eyes, but his stimulation of this area may have reached the underlying fibers of the optic radiations and had an effect similar to that from stimulation of the occipital cortex. Most investigators believe that the foot of the second frontal convolution exercises control over lateral associated eye movements (Bielschowsky).

Clinically, unilateral lesions of the upper tract for conjugate movement of the eyes are relatively frequent and the behavior of the eyes after a cerebral accident may indicate the seat of the lesion. The most common symptom is conjugate deviation with inability to move the eyes to the opposite side. This may be irritative or paralytic. For instance, it forms a part of many epileptic attacks and is almost constant in jacksonian fits affecting the muscles of the head. In these (irritative) cases the eyes are directed away from the side of the lesion. As a paralytic phenomenon conjugate deviation occurs in apoplectic seizures, especially when the second and third frontal convolutions are affected. Klaas describes such a case in full and refers to many more. In these cases the eyes are turned toward the side of the lesion and remain deviated for a varying length of time.

When the conjugate deviation occurs as part of a convulsion, it lasts only during the convulsion. In the paralytic cases also, even though the whole motor cortex or the internal capsule is destroyed, the conjugate deviation of the eyes is only temporary.

This fleeting deviation of the eyes from interference with the upper tracts contrasts with that due to destruction of the lower centers or tracts, which is permanent. When the dorsum of the pons is destroyed, for instance, there is often lasting deviation away from the side of the lesion. As the French say: "Le malade regard ses membres paralysés."

It sometimes happens that both sides of the cerebrum become softened, one after the other, in the condition known as pseudobulbar palsy. The behavior of the eyes in this condition is described by Wernicke,[38] Oppenheim [36] and others (vide infra).

Since the cerebral paralysis of associated lateral movements is merely temporary even though the center on one side is destroyed, it must be assumed that the function of lateral oculogyration is taken up by another area. That this cannot be consummated immediately is shown by the time elapsing before normal function is restored. It is supposed that the cortex of the opposite side takes on the function of the area destroyed. Lewandowsky says that destruction of one cerebral peduncle fails to cause permanent paralysis of associated lateral movements and Bielschowsky says that in some experiments in stimulating the cortex, conjugate lateral movements have been obtained to the same side, though it is admitted that these movements are usually replaced by those in the opposite direction.

When bilateral lesions affect the motor tracts for the eyes as in pseudo-bulbar palsy, there is bilateral paralysis of associated movements, but in these cases only the voluntary turning of the eyes is prevented, while the automatic and reflex movements are retained. Roth [37] and especially Bielschowsky [34] have given the following method of differentiating this supranuclear paralysis of associated lateral movements from that due to disease of the lower centers and roots: "Direct the patient to fix an object directly in front of him, and then turn his head passively to the sides. The eyes will turn to the physiological lateral limit, in a manner that was not possible through voluntary control. Sometimes in following a moving object the eyes will turn to the sides normally, yet the patient cannot voluntarily look to either side."

In these cases only the voluntary mechanism is out of order and the other centers remain intact. Thus visual and auditory stimuli are capable of causing associated ocular movements entirely beyond the control of the will. This is discussed under "Nystagmus."

Cerebellum.—Thomas [20] ablated half of the cerebellum of monkeys and observed conjugate deviation of the eyes to the opposite side, lasting from one to twenty days. When the vermis was intact there were no symptoms, but injury to the vermis always caused nystagmus. Gaussel [23] concludes that conjugate deviation is seen in acute lesions of the cerebellum, but not in slowly advancing ones. Paralysis of associated lateral movements without conjugate deviation is not a cerebellar symptom, but due to pressure on the subjacent centers for associated movements.

Corpora Quadrigemina.—Stimulation of the anterior corpora quadrigemina produces conjugate deviation of the eyes, but destruction of these bodies does not cause paralysis of associated lateral movements, and stimulation of the underlying tissues produces the conjugate movements as before. This seems to signify that the fibers for oculogyration run beneath the corpora quadrigemina and that a lesion of the corpora quadrigemina causes conjugate paralysis only when it involves the upper part of the pons (Gaussel).

From this review it may be stated that:

(1) Associated lateral movements of the eyes are possible of control bilaterally in the cerebral cortex.

(2) Unilateral lesions of the brain above the cerebral peduncles cause only temporary paralysis of associated lateral movements.

(3) The cerebellum and corpora quadrigemina are not the lower centers for lateral oculogyration.

TYPES OF PARALYSIS

Lateral movements of the eyes require the concerted action of the external rectus of one side and the internal rectus of the opposite side; that is, of the sixth nerve on one side and the third on the other. Therefore an intimate connection between these nuclei is necessary. This connection is generally conceded to be the posterior longitudinal fasciculus. Concerning this tract Déjerine writes:

> Fibers of very early myelinization going in both directions connect the nucleus of the abducens with the oculomotor nucleus on the same side for the purpose of associating the lateral movements of the eyeballs. These internuclear fibers take their origin from small cells contained in the oculomotor and abducens nuclei and pass by the posterior longitudinal fasiculus.

The small cells in the upper part of the abducens nucleus of the right side, for instance, can bring into action the small cells of the oculomotor nucleus of the same side, and cause parallel movements to the right. An exactly similar mechanism is elaborated for the conjugate movements to the left. Déjerine continues:

> Thus is formed a physiologic association tract, consisting of a dextrorotatory system which carries the glance to the right and a levorotatory system which carries the glance to the left, an association path which can be stimulated and activated not only by the cerebral cortex, but also by several central paths, auditory, labyrinthine, tactile, visual, etc.

It will be noticed that no mention is made of a decussation of the posterior longitudinal fasciculus between the sixth and the third nuclei. In spite of numerous attempts to establish such a fact, no satisfactory evidence of such decussation has been found. But Bernheimer[15] and others have found experimentally that the internal rectus of one side is controlled from both sides of the brain-stem, and Bruce, after a careful study of his case, in which he found ascending degeneration of the posterior longitudinal bundle ending in the oculomotor nucleus of the same side, says: "It is known that some of the fibers of the oculomotor nerve arise from the opposite nucleus. If these are the fibers to the internal rectus there need be no decussation of the posterior longitudinal bundle."

It was suggested that the fibers of the internal rectus might arise from the nucleus of the opposite external rectus, but in every case of paralysis of associated lateral movements of the eyes in which there has been no direct involvement of the oculomotor nucleus, the oculumotor nerve has been normal. Therefore the connection between the abducens nucleus and the internal rectus muscle must be indirect.

In paralysis of associated lateral movement ordinarily the internal rectus of the opposite side is paralyzed for this function only. The eye that cannot be brought beyond the midline in looking to the side, will roll in until the cornea reaches the inner canthus, in a strong effort at convergence. But in some cases convergence also fails, and Spitzer concluded that there were some fibers for convergence reaching as far down as the abducens nucleus. This loss of the power of convergence is noted in many cases in which large lesions have greatly distorted the whole pons. In our case, on Nov. 11, 1919, when paralysis of associated lateral movements was first noted, convergence was preserved. By March, 1920, it had failed until the right eye scarcely passed the median line, and at last it practically disappeared.

Lewandowsky says that convergence is a very unstable mechanism, and its loss from lesions below the oculomotor nucelus is a pressure effect rather than one of direct involvement.

The before-mentioned condition first noted by Féréol, that covering the eye that is paralyzed for external rotation allows the other to perform normal movements of adduction, has aroused a good deal of discussion. Some have postulated a separate tract from the cortex to the internal rectus that would account for the power of the single muscle when binocular vision was excluded, but, as Bielschowsky[2] points out, it is a fundamental conception that the lateral movements of the eyes are always associated.

> There is no point in the cortex—at least in man—from which isolated movements of one eye can be obtained. Also clinicopathologic observations teach that in unilateral lesions of the cortex, especially the hemispheres, there are always bilateral disturbances of eye movements. Both eyes seem to be, in motor as well as in sensory respects, a single organ.

To explain the activity of the eye in monocular vision that is paralyzed for binocular vision, some other hypothesis is needed. The phenomenon is best explained by the maintenance of the power of convergence, as was insisted by Bielschowsky. He pointed out that no mention was made of the behavior of the eye under cover, whether it rotated inward in conjunction with its fellow, or whether there were pupillary changes corresponding to the reaction of accommodation. He mentions several ways in which seemingly dissociated movements of the eyes may be obtained, but they all hinge on the convergence mechanism. Later Neumann[104] found that there was inward rotation of the covered eye, and narrowing of the pupil, thus confirming Bielschowsky's opinion.

An example of the opposite of this phenomenon has been described by Bernheimer.[49] In his case, covering the eye whose internal rectus was paretic for associated lateral movements, allowed the external rectus of the opposite eye to functionate normally. Bernheimer seems to have concluded (Bielschowsky[2]) that when one eye is covered the impulse to lateral movement is carried to the eye muscle nuclei by other routes than during binocular tests. In this condition there is no other explanation beyond that of a disputed divergence mechanism, so that the maintenance of power in the external rectus for monocular vision with the paralysis for binocular vision is stronger evidence for the individual innervation of the eye muscle nuclei. But the basic principle of parallel conjugate movements controlled by a supranuclear center still holds, and Bielschowsky, in discussing the case, says:

> I would rather believe that in cases like Bernheimer's, the paralysis of the associated muscles was not absolutely equal, and that the least damaged muscle would react for monocular tests when it would not for binocular tests, because abhorrence of the inevitable diplopia resulting from unequal contraction of the associated muscles would be sufficient cause for a complete failure of impulses to associated lateral movement.

Including this case of Bernheimer's, there are, then, four different manifestations of paralysis of the external rectus in relation to the internal rectus of the opposite side: 1. The cerebral or supranuclear in which in cases of pseudobulbar palsy the eyes cannot be made to move to the sides through control of the will, but yet are able to be brought into extreme deviation by tests for reflex movements of the eyes. 2. Paralysis from involvement of the nerve root or the nerve itself in its course through the cranial cavity. In this condition the internal rectus of the other eye is not affected. 3. Paralysis of associated lateral movements with maintenance of the power of convergence, the nuclear type of paralysis that forms the subject of this paper. 4. The type reported by Bernheimer, in which there is paralysis of associated lateral movement, yet with the covering of the sympathetic eye, the external rectus of the other eye is functionally active. The inference that may be drawn from this important case will be considered later.

THE LOWER CENTER

There is a mass of conflicting evidence and theory concerning the existence of a center in the pons governing conjugate lateral movements of the eyes. The chief objection to its presence is the failure to find any definite group of cells that can be called a center (Marburg) although von Monakow, and later Bernheimer [1] describe scattered columns of cells in the neighborhood of the aqueduct of Sylvius that are supposed to be in connection with the posterior longitudinal bundle, and through it with the eye muscle nuclei. Parinaud,[13] Poulard, Raymond [116] and Guillain accept this. Arguing from analogy, it may be said that there is no demonstrable center apart from the nuclei of the respective nerves for the movement of convergence or for the symmetrical action of the muscles of the larynx, yet there must be a very close connection between the two sides of the brain for the performance of these acts. Most authors consider the center for associated lateral movements, if there be such a group of cells, to be in the neighborhood of the abducens nucleus. Uhthoff [10] is the chief exponent of this conception from examination of the cases of Féréol, Wernicke [140] and others.

Grasset and Gaussel, Hunnius,[91] Wernicke,[140] Benvenuti, Bach and others believe that the center is the sixth nucleus itself. But Spitzer points out that the cases of Quioc, Garel, Hunnius [93] and Senator showed no lesions of the nucleus itself; and Uhthoff mentions the case of Siemerling, one of taboparesis of many years' duration, as one in which the sixth nucleus was almost completely destroyed without paralysis of associated lateral movements of the eyes. Siemerling summarized the case incorrectly, however, for in the full report of the case, not only is there no mention of paralysis of the external rectus, but both abducens nuclei are reported as being untouched. Frey reported a case of bilateral abducens paralysis with preservation of vertical movements and of normal movements of the internal rectus. Necropsy showed a tubercle involving the left abducens nucleus, posterior longitudinal bundle and the intrapontile fibers of both sixth nerves. This is the only clear case of isolated paralysis of the external rectus from a nuclear lesion that I have been able to find, and I have looked specifically for this condition, as I consider it of great importance in the question of a center. Siemerling's case is beyond consideration, and in Frey's case, in which there was paralysis of divergence and marked internal strabismus of both eyes, it would be impossible to determine paralysis of associated movements to the sides.

On the other hand, minute lesions involving the abducens nucleus and very little of the surrounding territory, but still causing paralysis of associated movements of the eyes, have been reported by Bennett and Savill, Benvenuti, Bloch and Guinon, D'Espine and Démolé, Garel, Hallopeau, Ormerod, Rohmer, Rohmer and Hoche, Seggel, and Wierzma.

Bielschowsky believes the actual center is in the tegmentum of the pons near the abducens nucleus. Lewandowsky,[6] following von Monakow,[8] considers it to be "near the abducens nucleus, anterior and close to the abducens, beside it, within it, and between it and the posterior longitudinal fasciculus," a sufficiently wide range of possibilities. Marburg, in his review of the literature, rejects the idea of an actual center, saying: "The lesion in Hunnius' case was above the sixth nucleus, that of Hallopeau's was within it, and that of Senator's was ventrolateral to the nucleus, still within the tegmentum of the pons, but neither in the posterior longitudinal fasciculus, nor in the sixth nucleus." It will be seen, however, in the case reports at the end of this paper, that in Senator's case there was oculomotor paralysis of the other eye, so that it cannot be considered one on which to base a conclusion as to the existence of a center.* Marburg concludes that:

> No one of the different centers proposed by different authors can explain all the manifestations, so that it seems best entirely to eliminate the idea of a center for lateral associated movements (Blickzentrum). Paralysis of associated lateral movements speaks for a lesion in the tegmentum of the pons, lying mostly medial and dorsal, usually involving the posterior longitudinal bundle and the abducens nucleus.

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* This type of paralysis may be termed spurious paralysis of associated movements. It is true that neither eye can be moved beyond the midline to that particular side, but it is due to actual paralysis of the internal rectus on one side and of the external rectus on the other. It may be differentiated from the true form by recognition of the ptosis, the limitation of the other movements, and especially by the failure of the convergence reaction. It is peripheral rather than central. Since this paper was written I have studied a case of basilar meningitis in which this condition was present. Neither eye would move to the right beyond the midline, but there was oculomotor palsy on the left side, with ptosis, and limitation of all except outward movement in that eye, whereas in the right eye there was a sixth nerve paralysis. There was no convergence reaction obtainable in the left eye.

Practically all authors agree that the posterior longitudinal bundle carries the impulses for lateral movements of the eyes between the third and the sixth nuclei, although Lewandowsky describes another connection that he has found in lower animals between the two nuclei, and Bruce speaks of an ascending strand of degenerated fibers that split off from the posterior longitudinal bundle and was lost to view. The posterior longitudinal bundle is so well defined in contradistinction to the vagueness of a special center, that Marburg has suggested that it is the fibers themselves, and not any nucleus, destruction of which causes the symptom of paralysis of associated lateral movements. But the fibers of the bundle must come from cells, and these cells, whether they are grouped or scattered, constitute the center for associated movements. Moreover, it has been shown by Seggel that many of the fibers making up the bundle arise from cells in the upper part of the abducens nucleus.

I think the evidence furnished by the cases reported is insufficient to exclude the abducens nucleus as the center for the associated movements to the same side. The posterior longitudinal fasciculus certainly is the tract by which impulses are carried both to the nucleus and away from it, a combined afferent and efferent tract. It is almost certain that it is by this route that fibers from the cortex reach the abducens nucleus, and Spitzer, Bertelsen and Rönne, Bruce and others insist, though Lewandowsky opposes this view, that it carries ascending fibers from the abducens nucleus to the oculomotor nucleus. Since the ascending and descending fibers lie side by side in the posterior longitudinal bundle, usually both sets are caught by any lesion involving the posterior longitudinal bundle, but Bernheimer's case, and others that will be mentioned later, seem to show that the recurrent tract can be involved without the descending one.

With the foregoing in mind, the anatomy of the tracts for conjugate eye movements may be mapped out, and the four types of paralysis of the external rectus with relation to the internal rectus of the opposite side set on an anatomic and physiologic basis.

TRACTS FOR LATERAL EYE MOVEMENTS

1. The motor tract for associated movements of the eyes, for instance to the right side, begins in the cerebral cortex, mostly of the left side, and runs down through the knee of the internal capsule and the cerebral (Déjerine) peduncles as far as the posterior commissure. Here a subtotal decussation takes place, the fibers continuing down in the posterior longitudinal fasciculus, mostly of the right side. It is possible that there is a synapse for some of the fibers in the nucleus of the posterior longitudinal bundle slightly above the level of the

oculomotor nucleus. A lesion of this tract and of its fellow of the opposite side as far down as the level of the third nucleus, will cause the supranuclear paralysis, in which the eyes cannot be moved voluntarily to the sides, but will react to the stimulation through reflex paths (Neumann, possibly Bárány, Wernicke).

2. In the posterior longitudinal bundle, descending fibers run down to the level of the right sixth nucleus. As this nucleus lies almost adjacent to the bundle, there is no distinct tract connecting the two structures. A lesion of this tract or of the abducens nucleus itself will cause paralysis of associated movements to the right, and if the third nucleus is not involved there will be preservation of convergence and of vertical movements. This is the nuclear type of paralysis in which the great majority of the cases fall. Bertelsen and Rönne describe such a case in which there was a selective degeneration of only one portion of the posterior longitudinal fasciculus, that lying in the central portion of each bundle.

3. The right abducens nucleus is the origin of the peripheral fibers going to the external rectus of the right eye. Destruction of this root or of the nerve after its departure from the brain-stem will cause paralysis of the external rectus without any involvement of the internal rectus of the left eye.

4. The right abducens nucleus is also the origin of fibers running up to the oculomotor nucleus of the same side, a peripheral tract as far as the abducens nucleus is concerned, yet a supranuclear tract on the part of the third nucleus. It may be called the internuclear tract (Fig. 5). A lesion here will cause isolated paralysis of the left internal rectus for lateral associated movements, with preservation of its power in movements of convergence. Bernheimer's case comes in this category. I have found two others in which this was certain, and four more in which it was suggested. In Bielschowsky's case[2] there was paralysis of both internal recti for associated movements to the sides, with preservation of the power of the external recti and nearly normal power of convergence. In Bruce's case there was complete paralysis of conjugate movements to the left and great weakness of the left internal rectus for conjugate movements to the right. The right external rectus functioned normally. Bielschowsky's patient, who had trauma of the back of the head, recovered, but since the minute hemorrhage, which, in his opinion was located in the central gray matter, could cause paralysis of both internal recti for associated lateral movements, and no other symptoms, it would seem that the recurrent tract from the abducens nucleus to the oculomotor nucleus of the same side lay next to the raphé in each posterior longitudinal fasciculus.

It was this tract which was interefered with in Bernheimer's case. The lesion abolished associated movements of the eyes to one side, yet when the eye whose internal rectus was paralyzed was covered, the eye that failed to move outward in associated movements took on its normal function. For binocular movement, as Bielschowsky said, there was sufficient inhibition working through cortical tracts, owing to the abhorrence of diplopia, to keep both eyes from rotating, yet when the diplopia was excluded by covering one eye, the other would react to stimuli sent from the cortex.

To conclude, we may consider the abducens nucleus the center for associated lateral movements of the eyes to the same side; the posterior longitudinal bundle the tract by which efferent stimuli are carried to the nucleus from the cerebral cortex and effernt stimuli from the abducens nucleus to the oculomotor nucleus of the same side; and this oculomotor nucleus the origin of the fibers to the opposite internal rectus muscle.

CONJUGATE DEVIATION

As was noted, conjugate deviation of the eyes is common in many lesions of the oculomotor tracts, either as an irritative or as a paralytic phenomenon. In lesions above the cerebral peduncles it is transient; as is paralysis of associated movements to the opposite side. If the lesion is irritative, the eyes turn to the opposite side; if paralytic, they deviate toward the same side.

Conjugate deviation in cerebral lesions is of little localizing value. According to Jacobi: "Transitory deviations of the eyes frequently seen after hemorrhage into any part of the brain, are due to the remote shock propagated to this nucleus" (the center for ocular rotation). Conjugate deviation is also seen in acute lesions of the cerebellum, both clinically and experimentally, due to the same "remote shock."

As a symptom of pontile lesion, conjugate deviation is apt to be permanent. Prévost, who first described the condition, found it in connection with hemorrhage into the pons.

There is a variance of opinion in assigning this phenomenon to any group of cells. Oppenheim[9] incriminates the vestibular fibers and thinks that destruction of Deiters' nucleus is accompanied by permanent conjugate deviation. Bennett and Savill believe that the sixth nucleus controls rotation of the head and eyes. In their case the lesion was only 2 mm. in diameter and situated exactly in the sixth nucleus. But fibers having their origin in Deiters' nucleus run through the sixth nucleus on their way to the posterior longitudinal bundle, fibers which are concerned, as will be seen later, with the production of nystagmus. It may have been destruction of these fibers in Bennett and Savill's case that caused the deviation. Against Oppenheim's theory is the fact of large growths having invaded Deiters' nucleus without the production of conjugate deviation.

It seems likely that in the pons, as in the cerebrum, acuteness of the lesion determines the conjugate deviation; in slowly advancing lesions compensation is effected, whereas in acute lesions it is not and conjugate deviation results. That frequently the head participates in the deviation supports this conception. The slow-growing widely extended glioma here reported was not accompanied by deviation; in Oppenheim's case a tubercle caused deviation of the eyes alone; whereas in Bennett and Savill's case, the minute lesion, thrombosis, caused deviation of both head and eyes.

Spitzer studied a case of large tubercle in the dorsum of the pons extending slightly across the midline to involve the opposite posterior longitudinal bundle. There was deviation of the head to the left and of the eyes to the right, with paralysis of associated movement of the eyes to the left. Spitzer explained the condition by assuming that tracts for lateral movements of the head and eyes run close together, that one bundle was destroyed, causing the eye symptoms, and that the other was "disturbed caudal to the sixth nucleus where it contained more of the head-turning fibers." His microscopic drawings of the posterior longitudinal bundles show the division of the tract into three portions and the degeneration of one portion. Déjerine described a similar case but without the minute findings.

It is probable that Oppenheim is correct in assigning to Deiters' nucleus the function of reflex conjugate deviation, as will be seen in the next section, and that the degree of deviation depends on the acuteness of the lesion.

NYSTAGMUS

When Bárány brought out his papers on the artificial production of nystagmus it was hoped that a short cut to the topical diagnosis of diseases of the brain-stem had been found. But the evaluation of these methods is yet to be made.

Douching the normal ear with cool water produces nystagmus in the opposite direction, explained by Bárány thus: Stimulation of the labyrinth excites the cells of Deiters' nucleus which send their impulses to the sixth nucleus. This reflex stimulation of the sixth nucleus causes conjugate deviation of the eyes to the side stimulated. In the extrinsic muscles of the eyeball there are large numbers of end-bulbs for the purpose of forwarding impulses of muscle sense to the central nervous system. The bulbs of the opposing muscles are stimulated by stretching and send impulses back to the brain-stem and up to the cortical or subcortical centers. These excite impulses to contraction in order to bring the eyes back to their primary position. The movement produced by the higher center is rapid in contradistinction to the slow reflex phase caused by excitation of the labyrinth. The alternation of these two stimuli causes the jerky oscillatory movement known as nystagmus.

The Bárány method is of use in diagnosing:

1. Destruction of the labyrinth, the vestibular nerve, or Deiters' nucleus. There is no movement of the eyes.

2. Peripheral paralysis of the external rectus. Only the unaffected eye moves.

3. Supranuclear paralysis of associated lateral movements of the eyes. In these cases there is slow conjugate deviation to the side of the stimulation. The path to and from the subcortical center is cut off, and the rapid phase of the nystagmus is absent.

How far it will be of value in detecting a lesion of the so-called nuclear tract, the posterior longitudinal bundle, is as yet undetermined.

Bárány himself studied a case of syphilitic infiltration of the corpora quadrigemina extending into the pons in which there was paralysis of associated movements of the eyes to both sides with partial oculomotor paralysis. The reflex lateral movements were preserved, and vestibular stimulation caused conjugate deviation instead of nystagmus. Brunner [60] found no vestibular reaction in his case in which there was paralysis of associated movements to the right, and necropsy showed a tubercle involving the triangular vestibular nucleus as well as the fillet and the posterior longitudinal bundle. Neumann [35] reported a case in which the lesion was similar to but not so extensive as Bárány's, in which there was absence of voluntary, but preservation of reflex, associated ocular movements, and in which stimulation of the labyrinth produced conjugate deviation instead of nystagmus. There was no necropsy examination. In the case which I present there was no nystagmus on douching the left ear, while on douching the right with the head thrown back there was a marked reaction upward and a tendency to conjugate deviation to the left. (This was before there was any paralysis of associated lateral movements.) Thus, there was probably destruction of Deiters' nucleus or its fibers, or of the vestibular nerve on the left side, no reaction being obtainable; and interference with the fibers on the right side coming from the cortex to provide the rapid phase of the nystagmus. The extent of the destruction could not be determined accurately in the sections on account of the characteristic mode of infiltration that is a feature of gliomatous tissue.

DIFFERENTIAL DIAGNOSIS

With an understanding of the tracts for the various movements of the eyes and the abnormalities of position and movement that take place as the result of interference with these paths, the differential diagnosis between lesions within and those outside of the pons becomes possible. Sufficient has been said concerning the paralyses of associated lateral movements of the eyes from lesions of the cerebrum, cerebellum and corpora quadrigemina to give indications for the diagnosis between lesions of the supranuclear tracts and the pontile tracts. It may be well to state, however, that lesions in the neighborhood of the anterior corpora quadrigemina cause paralysis of movements of elevation and possibly depression, as well as of associated lateral movements.

The differential diagnosis between a lesion of the pons itself, and a tumor lying in the cerebellopontile angle is now to be made as being of greatest importance in deciding for or against operation. Paralysis of ocular muscles, especially of the external rectus, is a common symptom in tumors of the acoustic nerve and in endotheliomas of the cerebellopontile angle. Interference with other movements of the eyes and with combined movements is of relatively frequent occurrence. Henschen found disturbances of motor nerves to the eye in ninety out of 125 cases of angle tumor. In fifty cases there was nystagmus in looking toward the side of the lesion. Ten cases showed paralysis of associated lateral movements of the eyeballs, or "something like it," and Henschen modifies this statement by saying that the paralyses were not sharply defined, and that this is not to be considered a part of the symptomatology of angle tumors. On the other hand, Lewandowsky says that "Tumors particularly can cause the symptom of paralysis of associated lateral movements of the eyes by influence at a distance (Fernwirkung), for instance through pressure on the pons from the side, or from the fourth ventricle." Urbantschitsch reports a case of otitis media in a girl of 8, who later developed an abscess in the cerebellum the size of a hen's egg. Here there was paralysis of associated movements of the eyes and of convergence. Cushing gives detailed descriptions of the behavior of the eyes. In one case there was "definite skew deviation"; in another, "conjugate deviation poorly sustained," and in a third, "conjugate deviation possible only to the right, and then with nystagmus; almost complete ophtalmoplegia."

That pressure at a distance from large tumors can interfere with conjugate movements of the eyeballs is certain, but clear-cut paralysis of associated lateral movements with preservation of the power of convergence, means a lesion of the posterior longitudinal bundle. This tract lies just to the side of the raphé of the pons, immediately under the floor of the fourth ventricle and the gray matter of the aqueduct of Sylvius. Hence it is in one of the most inaccessible portions of the brain, quite beyond the reach of surgery.*

In closing it may be well to quote some remarks of Spiller [109] on a case he studied in 1903. It was this case he recalled when examining our patient. He says:

> I think it well to emphasize the importance of paralysis of lateral associated movement of the eyeballs in clinical diagnosis. In such a case as the one described in this paper there might be some doubt whether the symptoms were caused by a tumor on the pons or by a tumor within the pons. As we have for some time past been trying to remove by operation a tumor upon the pons, or in the cerebellopontile angle, it is evident that if we could find a clinical sign indicating that the tumor was intrapontile, we would consider operation inadvisable when this sign was present. Such a sign I believe we have in paralysis of lateral conjugate movements of the eyeballs, and I should be unwilling to recommend operation for the removal of a pontile tumor if this form of ocular paralysis were present.

REPORT OF CASES

GROUP 1.—*Conjugate deviation, simple and transitory, from lesions of the upper tract.* Three cases (Dufour, Grasset,[84] Klaas).

Dufour: A woman, aged 37, had had a stroke with hemiplegia three weeks before and came into the hospital comatose and aphasic. Head and eyes deviated to the left. There was right homonymous hemianopsia. "She fixes, and follows with her eyes an object which is shown to her on the left side. Most often she stops looking at it when it goes to the right." She could make her eyes go to the extreme right by this method.

Necropsy showed a large area of softening in the left lenticular nucleus, the left internal capsule, the caudate nucleus and the surrounding white matter. Farther back the softening destroyed the retrolenticular segment of the capsule and the optic radiations.

GROUP 2.—*Paralysis of associated lateral movements of the eyes for volitional movements but retention of them in reflex movements; cases of pseudobulbar palsy.* Five cases (Wernicke,[38] Anton, Oppenheim,[36] Roth, Neumann.[35])

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* The epidemic of so-called lethargic encephalitis has brought into prominence the question of the behavior of the eyes. In this disease there is little meningeal involvement and it is probable that after escaping from the brain-stem the nerves are relatively free from danger, but in their course within the brain-stem, as Boyd has shown, the nerves may be compressed and their function abolished by the greatly swollen vessels, the perivascular round cell infiltration, and the edema. (Boyd reported this at the First Annual Meeting of the Association for Research in Nervous and Mental Diseases.) Should the same process occur in the floor of the fourth ventricle in the neighborhood of the posterior longitudinal fasciculus, we might expect transitory or permanent paralysis of associated lateral movements. This has rarely been observed. Barker reports in a personal communication the occasional mention in the literature of inability to move the eyes laterally, and I have observed a case in which there was paralysis of downward associated movements. On the whole, however, the syndrome of the posterior longitudinal fasciculus may be said to be of rare occurrence in the course of epidemic encephalitis.

Neumann: A man, aged 41, had difficulty in maintaining balance, and dimness of vision on looking to the sides. He had ataxia of the left arm, increased patellar reflexes, falling in any direction, usually forward. There was paralysis of associated lateral movements to the left, with marked weakness in movements to the right, but only for voluntary movement. "If the patient fixes an object which is moving, the eyes can be brought into the lateral angles." When the head is turned passively, the same movement results. There was no nystagmus on stimulation of the labyrinth, but the Bárány tests resulted in conjugate deviation.

Group 3.—*Unilateral paralysis of associated movements of the eyeballs from a pontile lesion, without deviation.* Twenty-nine cases (Annuske, Ballet,[42] Benvenuti, Bernhardt, Bleuler, Bruns, two, Cestan, Crohn, Féréol, Foville, Grasset,[85] Henneberg, Hery, Huguenin-Hofstetter, Hunnius,[91] Jolly, MacGregor, Meyer, Neumann,[104] Leyden, Parinaud, two, Potts and Spiller, Poulin, Raymond,[115] Raymond and Cestan,[117] Thompson, Johnson and Ferrier, Wierzma).

Féréol: There were hemiplegia of the right side, vomiting and headache, all of long standing. Intelligence and speech were not impaired. The right eye could be moved by itself freely, but in associated movements it would not move to the left beyond the midline. Convergence was maintained.

Necropsy examination revealed a tubercle the size of a cherry in the tegmentum of the pons making a bulge into the fourth ventricle. Beneath the surface, the lesion extended slightly beyond the midline.

Neumann: A boy, aged 4, in August, 1917, developed paralysis of the left abducens. By December he had left facial palsy, especially of the lower half. Right hemiplegia came on, and later paralysis of associated movements of the eyes to the left. There were bilateral vestibular disturbances. The muscles of mastication of the left side were paralyzed.

Necropsy revealed that all but a small part of the left half of the pons was a soft caseous mass. There were tubercles also in the cerebral peduncles and in the cerebellum.

Potts and Spiller: A man, aged 55, had marked weakness of the right arm and leg and weakness of the muscles of the left side of the face except of the orbicularis palpebrarum; also of the muscles of mastication. There was paralysis of associated movements to the left. Sensation of pain, touch, heat and cold was lost on the right side of the body. There was anesthesia of the left side of the face. Astereognosis and ataxia were present, more marked in the right hand.

Necropsy revealed above the entrance of the fifth nerve a tubercle in the tegmentum of the pons extending into the pyramidal tract on the left side. The left posterior longitudinal bundle was directly involved in its upper part. The fifth, sixth and seventh nerves of the left side showed degeneration.

Wierzma: A girl, aged 10, had left facial palsy, paralysis of associated movements to the left and of the left abducens. Convergence was preserved; the extremities were not affected. She complained only of headache.

A tubercle the size of a pea involving the sixth and seventh nuclei of the left side was found at necropsy.

Group 4.—*Paralysis of associated movements of the eyes to one side with conjugate deviation to the opposite side.* Forty-three cases (Ballet,[41] Beevor,[45] Bennett and Savill, Bloch and Guinon, Bristowe, Broadbent, Déjerine, five, Desnos, D'Espine, D'Espine and Démolé, deVincentiis, Dimmer, Finlayson, Finny, Garel, Graux, Hallopeau, Leyden, M'Aldowie, Mierzejewsky and Rosenbach, Mills, Oppenheim,[105] Parinaud, Peltier, Quioc, von Rad, Raymond,[115] two, Redlich, Rohmer, Rohmer and Hoche, Smith, Spitzer, Steinert, Thomas, Touche, two, Wernicke, Winkler):

Bennett and Savill: A woman, aged 67, had had a stroke with complete paralysis of the left arm. Two months later she woke up with her head and eyes deviated to the right. There was slight left facial paresis. There was paralysis of associated movements to the left, with preservation of the power of convergence and pupillary reactions. The head could not be turned to the left. Hearing in the left ear was poor. She died a month later.

Softening in the right ascending frontal convolution and an area of softening one-tenth inch (2.54 mm.) in diameter, limited to the sixth nucleus, were found at necropsy.

D'Espine and Démolé: A boy, aged 7, suffered with headache, loss of appetite and general malaise. He developed deviation of the head and eyes to the left, with paralysis of associated movements to the right. Complete right facial palsy was present. "By violent effort" the left eye could be moved in slightly, with resulting diplopia. Symptoms of tuberculous meningitis developed and he grew weak in the left arm. Death resulted in six months.

Generalized tuberculosis, tuberculous meningitis, multiple tubercles of the cerebrum, cerebellum and brain-stem were revealed at necropsy. A node 4 mm. in diameter occupied the eminentia teres. "On the right there is nothing left of the abducens nucleus but three or four cells" (in one cross-section). The right facial nerve was degenerated. The external border of the posterior longitudinal fasciculus was degenerated.

Hallopeau: A woman, aged 36, with endocarditis, pregnant eight months, had violent headaches one day. The next day there was deviation of the head and eyes to the right, and paresis of the left side of the face, both upper and lower portions. Her eyes would not go to the left in associated movements. She suffered from vertigo. She had hyperesthesia of the left side of the face and weakness of the right arm and leg. Internal squint developed in the left eye. She died of asphyxia.

Vegetative mitral valvulitis and ecchymosis, 2 mm. in diameter, in the floor of the left side of the fourth ventricle, occupying the left eminentia teres, in the position of the sixth and seventh nuclei were revealed at necropsy. There was a clot in the basilar artery from occlusion of the left vertebral artery by an embolus.

Quioc: A man, aged 54, whose first symptoms were headache and vertigo, had conjugate deviation of the head and eyes to the right, with paralysis of associated movements to the left. There was no diplopia, or paralysis of the extremities. He staggered in walking.

Necropsy revealed a tumor in the left protuberance anterior to the eminentia teres, not involving the sixth nucleus, but being able by its position to interrupt the root fibers of the sixth nerve, and encroach on the posterior longitudinal bundle. By a small prolongation to the right side, the lesion cut the raphé.

Rohmer: A man, aged 38, tuberculous, whose face was turned to the left and the eyes to the right, had no sensory or motor disturbances. The eyes could not be moved in association to the left. With the left eye closed, the right could be moved in all directions.

Necropsy revealed tubercles on the surface of the cerebrum and in the interpeduncular space. One tubercle was limited to the gray nucleus of the abducens on the left side.

Spitzer: A man aged 34, in the spring of 1896 had difficulty in looking to the left, and had vertigo on turning the head in that direction. The eyes were deviated to the right, and he had diplopia. He was troubled with headache and his health failed. In September the head deviated to the left and the eyes showed slight deviation to the right and could not be moved to the left in association. There was weakness of the left side of the face above and below. Convergence was limited. There was excessive salivation and moderate spasm of the muscles of mastication.

Necropsy revealed tuberculosis. There was a solitary tubercle in the floor of the fourth ventricle, centered about the triangular acoustic nucleus in the left side, extending over the midline in the deeper area. Medially the tumor involved the posterior longitudinal bundle on the left and to a slight extent on the right. It also involved Deiters' nucleus, the left abducens nucleus, the left facial nucleus, and the upper part of the dorsal vagus nucleus.

Group 5.—*Bilateral paralysis of associated movements of the eyes from lesions involving both posterior longitudinal bundles.* Twenty-three cases (Avramesco, Beck, Bertelsen and Rönne, Bischoff, Bleuler, Bramwell, Dutil, Fry, Grasset and Gaussel, Hirschberg, Jackson, Kolisch, Mabboux, Ormerod, Ransohoff, Raymond,[116] two, Raymond and Cestan,[117] two, Righetti, Seggel, Wernicke,[140] two).

Bertelsen and Rönne: A man, aged 50, had tuberculosis and syphilis, was alcoholic and had just had an attack of pneumonia. He complained of difficulty in seeing, and later in talking. He was delirious, and alcoholic neuritis set in. There was no ptosis or lagophthalmos of the eyes, the pupils gave no reaction to light but reacted well in convergence, the right being larger than the left. There was bilateral paralysis of associated movements of the eyeballs, both voluntary and reflex. The eyes were in the midline. Opening and closing the eyes caused rotatory nystagmus. Convergence was good.

Necropsy revealed poliencephalitis. At the aqueduct of Sylvius there were two small hemorrhages into the central gray matter, extending as far laterally as the posterior longitudinal fasciculi. Ganglion cells in the nucleus of the posterior longitudinal nucleus were slightly abnormal. At the level of the sixth nucleus there was an infiltration into the posterior longitudinal fasciculus on both sides. The degeneration ended with the sixth nucleus. Here there were some abnormal cells, about 25 per cent. The degeneration of the posterior longitudinal bundle was most marked in the medial portion. Except for the posterior longitudinal bundle, no degeneration was observed. The oculomotor nerve was normal.

Raymond and Cestan: A woman, aged 28, was weak on the left side and had diplopia on looking to either side. There were numbness of the mouth, anesthesia of the left hand and vertigo; hemiplegia of the left extremities and the lower part of the face, with exaggerated reflexes, astereognosis and ataxia. She had hypesthesia of the left arm, face and leg for all forms of sensation. She walked with a drunken gait and fell on attempting to turn around. There was loss of emotional control. Speech was scanning. Her eyes were in midposition and could not be moved to the sides in association, yet convergence was maintained. Optic neuritis developed late. The right side of the face became weak in both upper and lower halves.

Necropsy revealed tubercle of the pons and medulla. The third nucleus was untouched and the third nerve showed no degeneration. There was destruction of both posterior longitudinal fasciculi. The lesion spared the sixth nuclei but caught the fibers of both nerves.

Seggel: A man, aged 62, complained of failing vision on the right side, which was found to be due to choked disk. There was paralysis of the right abducens and of associated movements to the right. When the right eye was covered the left eye could be moved to the right. Convergence was good; there was no diplopia. The patient had headache and night sweats. Hearing was good. He had vertigo on turning. Later complete paralysis of the face and bilateral paralysis of the lateral associated movements developed.

Necropsy revealed a tubercle in the right side of the pons reaching over as far as the left facial fibers. Apparently it started in the right sixth nucleus and early involved the right facial fibers. Later it extended across the midline and destroyed the left sixth nucleus.

Group 6.—*Isolated paralysis of the internal rectus for lateral associated movements, from a lesion of the recurrent internuclear tract between the abducens nucleus and the oculomotor nucleus of the same side.* Three pure cases (Bernheimer,[49] Bielschowsky,[2, 51] two, Fischer); combined with paralysis of associated movements of both eyes to the opposite side, four (Bruce, Ewald, Hunnius,[91] Steinert; also Gubler and Huguenin. I could not verify these).

Bielschowsky: A man, aged 45, was hit on the head. He experienced no disturbance at first but that night there were severe headache, discomfort, dizziness and diplopia. Examination eight days later showed the right eye held shut. When it was opened it was found to be divergent 20 degrees. In looking to the sides neither eye could be adducted beyond the midline, yet convergence was nearly normal. The vertical movements were good, but attended with slight nystagmus. The external recti were functionally active in movements to the sides. The pupils were active to light and distance, and vision was good. There were no other neurologic disturbances. In a few days the divergence disappeared. The left internal rectus improved for associated lateral movements and the right rectus internus functioned normally after a year. Only slight nystagmus remained on turning the eyes to the right. There was then complete freedom of associated lateral movements.

Bruce: A woman, aged 23, complained of vertigo, defective movements of the eyes and swaying to the right. Examination revealed paralysis of the left side of her face. There was complete paralysis of conjugate movements of the eyes to the left and slight paralysis of conjugate movements to the right, affecting especially the internal rectus. Convergence was preserved. Death resulted from tuberculous meningitis.

Necropsy revealed tuberculous meningitis of the base—a tubercle of the upper part of the pons projecting into the fourth ventricle, measuring 1.2 by 1 cm. It occupied the position of the two sixth nuclei and facial nerves as well as the posterior longitudinal fasciculi. There was ascending and descending degeneration of both posterior longitudinal fasciculi. The third nerve was normal.

Ewald: A man, aged 37, was tuberculous. The left eye would move neither out nor in; the right eye would move out but not in, in associated lateral movements. Closing the left eye made the abduction of the right eye more complete. Convergence was preserved. There were facial palsy of the left side and glycosuria.

Necropsy revealed a tubercle of the pons the size of a cherry stone. The specimen was turned over to Brasch for microscopic examination.

Group 7.—*Paralysis of lateral associated movements combined with paralysis of the elevators or depressors, from lesions in the neighborhood of the corpora quadrigemina.* Fourteen cases (Bárány, Kornilow, Leri and Perpére, Raymond and Cestan,[117] Raymond and Claude, Raymond and Rose, Schoeler, Schoenherd, Spiller,[137] four, Uhthoff).

Bárány: A man, aged 39, who had cerebral syphilis, had crossed paresis of the right fifth and the left seventh nerves, later involving the right seventh. He was deaf in both ears, had difficulty in swallowing and speaking, and complete paralysis of the tongue; he was weak on the right side, hypesthetic and ataxic and had retention of urine. He had ptosis of the right eyelid, later of his left. Conjugate movements to the sides were wanting. Very slow nystagmus developed on attempting to look to the sides or upward. The right eye was weakened in convergence and in upward movements. The weakness of associated movements became paralysis, and the nystagmus was lost. Bilateral ophthalmoplegia developed. Reflex conjugate lateral movements were preserved and on vestibular stimulation conjugate deviation was obtained instead of the normal nystagmus.

Necropsy revealed syphilitic infiltration of the corpora quadrigemina extending down into the pons.

Raymond and Cestan: In a man, aged 43, a week after a violent emotional disturbance speech became thick and weakness developed on the left side. He had diplopia on looking to the side. Examination revealed paralysis of the left arm and leg and of the lower half of the left side of the face, with exaggerated reflexes and intention tremor. There was moderate hypesthesia, especially in the distal parts and paralysis of associated movements of the eyes to both sides, and diminished power of elevating the eyes. Nystagmus was present. The condition remained unchanged for ten years.

Multiple areas of sclerosis involving the left pyramidal tract and the right posterior columns of the cord at different levels were found. Other areas centered about the aqueduct of Sylvius and enclosed the third nuclei but did not destroy them. Other smaller areas were found in the pons.

Spiller: A man, aged 31, had been paretic in the right extermities and in both sides of the face, especially the left, for nine months. The muscles of mastication were weak. There were fibrillary tremors of the left masseter muscle and of the right side of the tongue. Tendon reflexes were exaggerated in the right extremities, and there was moderate wasting of the muscles. There was paresis of associated movements of the eyes upward and to the left. Bulbar speech, impaired hearing on the left, anesthesia of the left cornea and optic neuritis were present.

Necropsy revealed a large tubercle involving almost the entire left side of the pons and invading a little of the right half, extending into the lower portion of the cerebral peduncle. Most of the nerve cells of the left oculomotor nucleus were displaced. The left third nerve was normal. The left sixth and the spinal root of the fifth were much degenerated, and the left seventh and the motor root of the fifth were partially degenerated. The left pyramid was invaded. The aqueduct of Sylvius was much compressed from the left side.

Group 8.—*Paralysis of the abducens and of the oculomotor branches that should not come under the classification of paralyses of associated lateral movements of the eyeballs;* three cases.

Senator: A man, aged 52, had an apoplectic stroke, and later headache and mental dulness; he was paralyzed on the left side. Speech was disturbed. He was alcoholic. Twice a year he had attacks of confusion and vomiting, with hot and cold flashes. Examination showed that his left leg was weak, and he had a tendency to fall to the left. Walking quickly made him dizzy. There was incomplete ptosis on the left. Movements of the left eye were limited in all directions. The right eye was limited in abduction in both monocular and binocular tests. The right pupil was smaller; both reacted slightly. Convergence was preserved, but to a subnormal extent. There was left facial palsy. The left side of the tongue was atrophic, protuded to the left and showed fine fibrilliary twitchings. There was anesthesia of the left half of the face, and paresis of the abductor of the left vocal cord. The knee reflexes were absent. Romberg's sign was positive.

Necropsy revealed an area of softening ventrolateral to the sixth nucleus, still within the tegmentum of the pons, but involving neither the left sixth nucleus nor the posterior longitudinal bundle (Marburg).

Uhthoff: A man, aged 45, had paralysis of both internal recti for lateral movements and for convergence. He had nystagmus. The patellar reflexes were increased. There was weakness of the left leg with ataxia. He had slight dementia.

Necropsy examination was not made. Diagnosis: Multiple sclerosis.

Bárány's case might be considered here.

I have recently observed a case of tuberculous meningitis with eye symptoms like those of Senator's patient, a spurious paralysis.

Group 9.—*Paralyses of associated movements of the eyes from lesions outside of the pons.* Six cases (Prévost, Urbantschitsch, Panas, Cushing[30]).

Prévost: The patient had paresis of the entire right side of the face and weakness of the right extremities. The eyes deviated to the left and could not be moved beyond the median line. There was diplopia on looking to the right.

Necropsy examination revealed a tumor the size of a hen's egg in the right cerebellar hemisphere.

Urbantschitsch: A girl, aged 8, had otitis media several weeks followed by partial recovery. One day she complained of headache, vomiting and pain in the neck. She was very sick. The right pupil was dilated. There was no Kernig's sign. She could not move her eyes to the left. A tache cerebrale was obtained. The pulse rate was 64, temperature normal. Examination of the left ear showed signs of recent inflammation and a polyp. The hearing was gone. At operation the mastoid antrum was found filled with inspissated pus. The patient died.

Necropsy revealed chronic otitis media in direct proximity to the left cerebellar hemisphere and in the hemisphere itself a destructive abscess the size of a hen's egg. There was no meningitis.

Panas: The patient had a progressive loss of sight for four years, with inability to move the eyes separately or conjugately in the lateral plane. Vertical movements were retained. There was spasm of the right arm and leg.

Necropsy revealed gray softening of the whole cortical layer of the left lobe of the cerebellum. The gray matter of the inferior vermis was the seat of a certain degree of softening. The cerebrum and brain-stem were healthy.

Gaussel thinks this may have been a case of compression. It is possible a minute lesion was overlooked for the symptoms are typical of a lesion involving both posterior longitudinal fasciculi.

Cushing: A woman, aged 37, complained at first of unsteadiness of gait, thickness of speech, immobility of the face and drooling at the corners of the mouth. There was numbness in the tongue. She was deaf on the left side. There was paresis of the left abducens. She was weak and showed loss of emotional control. She had severe headaches, vomiting, suboccipital discomforts and failing vision. The sense of smell and of taste became defective. Her mouth and lips were anesthetic. She had paresthesias of the left arm and it was ataxic. She staggered when she walked, showed a positive Romberg sign and nystagmus.

There was some fluctuation of symptoms from time to time, but three years later she had lost vision, hearing, sense of smell and sense of taste. Practically all the cranial nerves were involved: First nerve, anosmia; second, blindness; third, almost complete ophthalmoplegia, conjugate deviation possible only to the right, then with nystagmus; fifth, areflexia cornealis, hypesthesia, hypalgesia and bilateral paralysis of muscles of mastication; seventh, almost complete paralysis of both sides of the face; eighth, bilateral tinnitus preceding deafness—no labyrinthine response; ninth and tenth, ageusia, dysarthria, dysphagia; eleventh, and twelfth, uninvolved, tongue in midline. Thus ten of the twelve pairs of cranial nerves were paralyzed. The woman died suddenly. Necropsy revealed a very large acoustic tumor springing from the left side.

BIBLIOGRAPHY

GENERAL DISCUSSIONS

1. Bernheimer: Die Wurzelgebiete der Augennerven, ihre Verbindungen und ihr Anschluss, etc., Graefe-Saemisch Handbuch der ges. Augenheilkunde, Leipzig, 1899, Chapter 6.

2. Bielschowsky, A.: Die Bedeutung der Bewegungsstörungen der Augen, Ergebn. d. Chir. u. Orthop. **9**:123, 1916.

3. Déjerine, J. J.: Semiologie des affections du systéme nerveux, Paris, 1914, pp. 223 and 428.

4. Jacobi, M. P.: Essays on Hysteria, Brain Tumor, New York, 1888, p. 109.

5. Klaas: Ueber konjugierte Augenablenkung bei Gehirnkrankheiten, Inaug.-Dissert., Marburg, 1898.

6. Lewandowsky: Handbuch der Neurologie, Berlin, **1**:2, p. 733, 1910.

7. Marburg: Neuere Fortschritte in der topischen Diagnostik des Pons und der Oblongata, Deutsch. Ztschr. f. Nervenheilk. **41**:41, 1911, Bibliography.

8. Von Monakow: Gehirnpathologie, in Nothnagel's Handbuch, Vienna, Ed. 2, 1894-1915, pp. 599-621.

9. Oppenheim, H.: Lehrbuch der Nervenkrankheiten, Berlin, Ed. 6, 1913, pp. 914-1181.

10. Uhthoff: Augenstörungen bei den Pons, usw. Erkrankungen, Graefe-Saemisch Handbuch d. ges. Augenheilk., Leipzig, **11**: Pt. 2, 563-682, 1899. Bibliography.

11. Wallenberg: Neuere Fortschritte in der topischen Diagnostik des Pons und der Oblongata, Deutsch. Ztschr. f. Nervenheil. **41**:8, 1911.

12. Wilbrand and Saenger: Die Neurologie des Auges, Wiesbaden **1**:452, 1899-1921.

HISTORICAL

13. Parinaud, H.: Les paralysies des mouvements associés des yeux, Arch. de Neurol. **5**:145, 1883.

Peltier: Le syndrome de Foville, Thèse de Paris, 1913.

EXPERIMENTAL

14. Beevor and Horsley: An Experimental Investigation Into the Arrangement of the Excitable Fibers of the Internal Capsule of the Bonnet Monkey, Phil. Tr. Roy. Soc. London **181**:49-88, Series B, 1890.

15. Bernheimer: Die Gehirnbahnen der Augenbewegungen, Graefe's Arch. f. Ophth. **57**:363, 1903-1904.

16. Duval, Mathias and Laborde: De l'innervation des mouvements associés des globes oculaires, J. de l'anat., et physiol. **16**:56, 1880.

17. Grünbaum and Sherrington: Observations on the Physiology of the Cerebral Cortex of Some of the Higher Apes, Proc. Roy. M. & Chir. Soc. London **69**:206, 1902.

18. Prus: Untersuchungen über elektrische Reizung der Vierhügel, Wien. klin. Wchnschr. **12**:1124, 1311, 1899.

19. Sherrington: Integrative Action of the Nervous System, London, 1906, pp. 226, 280, 385.

20. Thomas: Thèse de Paris, 1897.

COLLECTIONS

21. Bleuler, E.: Zur Casuistik der Herderkrankungen der Brücke, Deutsch. Arch. f. klin. Med. **37**:527, 1885.

22. Delbanco, Ernst: Beiträge zur Symptomatologie und Diagnostik der Geschwülste des Pons Varolii, Inaug. Diss., Berlin, 1891.

23. Gaussel: Paralysie des mouvements associées de latéralité des globes oculaires, Rev. de méd. **25**:362, 1905.

24. Graux: Contribution a l'étude des localisations cérébrales, (mésocephales), Thèse de Paris, 1878.

25. Héry: Contribution a l'étude des tubercules de la protubérance, Thèse de Paris, 1899.

26. Hunnius: Zur Symptomatologie der Brückenerkrankungen, Bonn, 1881.

27. Quioc: Memoire sur la déviation conjugée des yeux et de la rotation de la face dans les lésions protubérantielles, à propos d'une tumeur de cette region, Lyon méd. **37**:313, 347, 385, 415, 1881.

29. Spiller: The Importance in the Clinical Diagnosis of Paralysis of Associated Movements of the Eyeballs (Blicklähmung) Especially of Upward and Downward Associated Movements, J. Nerv. & Ment. Dis. **32**:417, 1905.

CEREBELLO-PONTILE ANGLE TUMORS

30. Cushing: Tumors of the Nervus Acusticus, Philadelphia, W. B. Saunders Company, 1917.

31. Henschen: Ueber Geschwülste der hinteren Schädelgrube, Klinische und anatomische Studien, Jena, Fischer, 1910.

32. Wiesenburg and Work: The Diagnosis of Tumors in the Posterior Cranial Fossa, J. A. M. A. **65**:1345 (Oct. 16) 1915.

PSEUDOBULBAR PALSY

33. Anton: Beiderseitige Erkrankung der scheitelgegend des Grosshirns, Wien. klin. Wchnschr. **48**:1192, 1899.

34. Bielschowsky, A.: In discussion of case reports of Steinert, Deutsch. med. Wchnschr. **5**:316, 1903.

35. Neumann: Demonstration of Patient Before the k. k. Gesellsch. d. Aerzte in Wien., reported in Wien. klin. Wchnschr. **26**:909, 1913.

36. Oppenheim, H.: Kurze Mitteilung zur Symptomatologie der Pseudobulbarparalyse, Fortschr. d. Med. **13**:1, 1895.

37. Roth: Pseudobulbärparalyse, Neurol. Centralbl. **28**:1126, 1909.

38. Wernicke: Herderkrankungen des unteren Scheitelläpchens, Arch. f. Psychiat. u. Nervenkrankh. **20**:243, 1889.

CASE REPORTS * †

* Signifies necropsy findings; † signifies figure in text.

39. * Annuske: Neuritis optica bei Tumor cerebri, Case 3, Graefe's Arch. **19**: No. 3, 248, 1873.

40. Avramesco: Paralysies des mouvements associés de latéralité à droite et à gauche des globes oculaires' Rev. Roumaine Spitalul **10**:81, 1906; Ref. Rev. neurol. **17**:28, 1909.

41. * Ballet, G.: Syphilis cérébrale; paralysie du moteur oculaire externe à droite; déviation conjugée, Progres méd. **8**:766, 1880.

42. Ballet G.: Sclerose en plaques à symptomes transitoires et recidivants. Paralysie temporaire des mouvements associés des yeux, Rev. neurol. **10**:437, 1902.

43. * Bárány, R.: Die Untersuchungen der reflektorischen vestibulären und optischen Augenbewegungen und ihre Bedeutung für die topische Diagnostik der Augenmuskellähmungen, München. med. Wchnschr. **54**: No. 1, 1072, 1907.

44. * Beck, O.: Zur Diagnostik der Ponstumoren. Vestibuläre Zwangstellung der Augen, Monatschr. f. Ohrenh. **49**:732, 1915.

45. * Beevor, H.: Two Cases of Brain Stem Tumor, Report of Committee on Intracranial Growths, Tr. Path. Soc. Lond. **37**:82, 1886.

46. † * Bennett and Savill: A Case of Permanent Conjugate Deviation of the Eyes and the Head, the Result of a Lesion Limited to the Sixth Neucleus, Brain **12**:102, 1889.

47. † * Benvenuti: Sulle patologia del ponti di Varolio, Ann. di nevrol. **19**: 97, 1901.

48. * Bernhardt: Einen Fall von Ponstumor, Berl. klin. Wchnschr. **18**:143, 1881.

49. Bernheimer: Ueber Störungen von Blickbewegungen, Bericht über d. 77 Versamml. Deutsch. Naturf. u. Aerzte, Med. Abth., Discussion, 1905, p. 280.

50. * Bertelsen and Rönne: Ein Fall von Polioencephalitis mit assoziirter Blicklähmung supranukleärer Ursprungs, Monatschr. f. Psychiat. u. Nervenkrankh. **25**:148, 1909.

51. Bielschowsky, A.: Die Innervation der Musculi recti internes als Seitenwender, Bericht u. d. 30 Versamml. Deutsch. Ophth. 1902, p. 164.

52. Bielschowsky, A.: Ueber den reflektorischen Charakter der Augenbewegungen, Klin. Monatschr. f. Augenheilk. **45**:67, 1907.

53. † * Bischoff: Zwei Geschwülste der Brücke und des verlängerten Markes, Jahrb. f. Psychiat. **15**:137, No. 2-3, 1897.

54. † * Bleuler: Zur Casuistik der Herderkrankungen der Brücke, Deutsch. Arch. f. klin. Med. **37**:527, 1885.

55. * Bloch and Guinon: Sur un cas de paralysie conjugée de la sixième paire, Arch. de med. exper. et d'anat. path. **3**:74, 1891.

56. † * Bramwell, B.: A Remarkable Case of Hemorrhage of the Pons Varolii and Medulla Oblongata, Edinburgh M. J., N. S. 2, 1909, p. 129.

57. * Bristowe: Recent Tubercle of the Pons Varolii, Brain **14**:289, 1891.

58. * Broadbent: There were two small tumors just beneath the floor of the fourth ventricle, Med. Times and Gaz. 1872, p. 554.

59. † * Bruce: A Case of Double Paralysis of Conjugate Deviation of the Eyes, Rev. Neurol. & Psychiat. **5**:329, 1903.

60. † * Brunner, H.: Bemerkungen zum zentralen Mechanismus der vestibulären Nystagmus, Monatschr. f. Ohrenheilk. **53**:1, 1919.

61. * Bruns: Ueber einige seltenere Affektionen des Hirnstammes. Fall 4. Glioma pontis, Ref. in Neurol. Centralbl. **7**:311, 1888.

62. * Bruns: See Hery, Thèse de Paris, 1899.

63. * Cestan, R.: La paralysie des mouvements associés de latéralité des globus oculaires, Toulouse med. **13**:321, 1911; ref. in Rev. neurol. **24**:344, 1912.

64. * Crohn: Ein Fall von Solitärtuberkel in Pons bei tuberkulöser meningitis, Arch. f. Kinderheilk. **4**:91, 1883.

65. † * Cushing: Tumors of the Nervus Acusticus. Three Cases, Philadelphia, W. B. Saunders Company, 1917, pp. 65, 82, 134.

66. † * Déjerine, J. J.: Semiologie des Affections du Systeme Nerveux, Paris, Masson et Cie, 1914, p. 222.

67. † * Desnos: Hémorrhagie de la protubérance annulaire, rotation de la tète et déviation conjugée des yeux du côté opposé à la lesion, Bull. de la Soc. med de hôp. **10**:87, 1873.

68. * D'Espine, A.: Abscès tuberculeux et tubercules crus mutliples du pont de varole, Rev. med. de la Suisse Rom. **6**:371, 1886.

69. † * D'Espine and Demole: Tubercules de la protubérance, Arch. de Med. d'Enf. **20**:355, 1917.

70. † * deVincentiis: Contributione allo localizazioni cerebrali strabismo conjugato paralitico, Ann. di Ottal. **12**:274, 1883.

71. * Dimmer: Ein Fall von konjugierter Deviation beider Augen, Wien. klin. Wchnschr. **12**:581, 1899.

72. * Dufour, H.: Du syndrome "deviation conjugée de la tète et des yeux," Rev. Neurol. **13**:1199, 1905.

73. * Dutil: Note sur un cas d'hémorrhagie bulbaire, Ser. 7, Gaz. med. de Paris, **4**:399, 1887.

74. * Elzholz: See Peltier, Thèse de Paris, 1913, ref. 13.

75. * Ewald: Demonstration eines isolierter kirschkerngrosser Tuberkel in pons bei assoziirter Seitwärtslähmung ders linken Auges, Verh. d. Berl. med. Gesellsch. **32**:176, 1901.

76. * Féréol: Note sur une paralysie de la sixième paire gauche avec inaction du muscle droit interne de l'oeil droit, L'Union med. **47**:247, 1873.

77. * Finlayson: Case of Tumor in the Floor of the Fourth Ventricle, Glasgow M. J. **29**:338, 1888.

78. † * Finney: Tubercular Tumor of the Pons, Dublin J. Med. Sc. **87**:380, 1889.

79. Fischer: Isolierte Lähmung eines Muskel rectus infernus als Seitenwender, Prager med. Wchnschr. **30**:677, 1905.

80. *Foville: Note sur une paralysie peu connue de certains muscles de l'oeil, et sur sa liaison avec quelques points de l'anatomie et la physiologie de la protubérance annulaire, Gaz. hebd. **4**:10, 1859.

81. * Frey, E.: Ueber einen Fall von Oblongatatuberkel unter dem Bilde eines Kleinhirnbrückenwinkeltumors, Ztschr. f. d. ges. Neurol. **21**:130, 1913.

82. Fry, F. R.: A Case of Congenital Double Facial Paralysis Accompanied by Absence of Lateral Movements of the Eyeballs, Mandible and Tongue. Med. Rec. N. S. **107**:30, 1919.

83. * Garel, J.: Nouveau fait de paralysie de la sixième paire avec déviation conjugée dans un cas d'hémiplegie alterne, Rev. méd. **2**:593, 1882.

84. Grasset: Un type spécial de paralysie alterne motrice, Rev. neurol. **8**: 586, 1900.

* Grasset: De la déviation conjugée de la tète et des yeux, Montpelier méd. **1**:323, 57, 1878.

85. * Grasset, J.: La déviation conjugée des yeux et l'hémianopsie, Rev. neurol. **12**:645, 676, 800, 1904.

86. * Grasset and Gaussel: Tubercule de la protubérance, Rev. neurol. **13**: 69, 1905.

87. * Hallopeau: Note sur un fait de thrombose basilare, Arch. de physiol. norm. et. path., Ser. 2, **3**:794, 1876.

88. * Henneberg: Ueber Ventrikel und Ponstumoren, Charité Ann. **27**:493, 1902; Ref. Neurol. Centralbl. **23**:24, 1904.

89. Hirschberg: Ein Fall von Tuberkulöser Geschwülstbildung in Pons und in der Aderhaut beider Augen, Neurol. Centralbl. **1**:553, 1882.

90. * Hofstetter: Zur Casuistik der Ponstumoren, Zurich Dissert., Zug. 1880, given by Bleuler.

91. † * Hunnius: Zur Symptomatologie der Brückenerkrankungen, Bonn, 1881.

92. * Jackson, H.: Hemiplegia; Lateral Deviation of the Eyes from the Side of the Lesion; Aphasic Symptoms; Tubercle in the Pons Varolii, Med. Times & Gaz. **48**:6 and 96, 1874.

* Jackson, H.: Lateral Deviation of the Eyes from Disease of the Pons Varolii, Ophth. Hosp. Repts. **8**:325, 1875.

93. † * Jolly: Ueber einen Fall von Gliom im dorsalen Abschnitt des Pons und der Medulla oblongata, Arch. f. Psychiat. u. Nervenkrankh. **26**: No. 3, p. 619, 1894.

94. * Kolisch, R.: Ein Fall von Ponstumor, Wien klin. Wchnschr. **6**:252, 1893.

95. Kornilow: Zur Frage der Associationslähmungen der Augen, Deutsch. Ztschr. f. Nervenh. **23**:417, 1903.

96. Léri and Perpère: Un cas de syndrome de Foville, pédonculaire, Rev. Neurol. **33**:530, 1918.

97. * Leyden: Klinik der Rückenmarkskrankheiten. II. Die Krankheiten des Rückenmarks selbst. Die Blutungen der Medulla oblognata. Mitteilung eines eigenes Falles von Blutung in Pons und Medulla oblongata, Berlin, Hirschwald, 1875, p. 63.

98. Mábboux: Paralysie du muscle droit externe avec inaction conjugé du droit interne opposé, Ann. d'Oculis, **106**:31, 1891.

99. * MacGregor, A.: Case of Tumor of the Pons Varolii and Medulla Oblongata, Lancet **2**:1127, 1886.

100. McAldowie: Case of Alternate Hemiplegia, Brain **3**:125, 1880.

101. †*Meyer, Paul: Ueber einen Fall von Ponshemorrhagie mit sekundären Degenerationen de Scheife, Arch. f. Psychiat. u. Nervenkr. **13**:63, 1882.

102. † * Mierzejewsky und Rosenbach: Zur Symptomatologie der Ponserkrankungen, Neurol. Centralbl. **4**:361, 385, 1885.

103. * Mills: Two Cases of Disease of the Brain, Brain **2**:547, 1879.

Mills: Tumor of the Pons Varolii with Conjugate Deviation of the Eyes and Rotation of the Head, J. Nerv. & Ment. Dis. **6**:470, 1881.

104. * Neumann: Konglomerattuberkel des Pons, Deutsch. med. Wchnschr. **44**:871, 1918.

105. * Oppenheim, H.: Ponstuberkel mit seitliche Blicklähmung, Charité-Ann. 1883, p. 342.

106. * Ormerod: Gummata of Pons Varolii, Brit. M. J. 1889, p. 1277.

107. * Panas: Perte des mouvements horizontaux des yeux; ramollissement du cervelet, Soc. de chir. **1**:433, 1875.

108. Peltier: Thèse de Paris, 1913.

109. * Potts and Spiller: A Case of Solitary Tubercle of the Pons, U. of Pa. Med Bull. **16**:362, 1903.

110. * Poulin: Tubercule dans le plancher du quatrième ventricule au niveau de la sixième paire du côté droit, Prog. méd. **8**:186, 1880.

111. *Prévost: De la deviation conjugée des yeux et la rotation de la téte dans certains cas d'hemiplegie, Thèse de Paris, 1868.

112. † * Quioc: See reference 27.

113. * Von Rad: Fall von Tumor. Salitärtuberkel in der rechten Ponshälfte, Ophth. Klin. **4**:147, 1900.

114. † * Ransohoff, A.: Ueber einen Fall von Erweichung im dorsalen Teil der Brücke, Arch f. Psychiat. u. Nervenkr. **35**:402, 1902.

115. Raymond: Leçons sur les maladies du systeme nerveux, II, III, IV, VI, cases presented, Paris, Doin, 1896-1903.

116. * Raymond: Sur deux cas d'hemiplégie compliquée d'une paralysie des mouvements associés des yeux, Progres méd. **31**:49, 1902.

117. * Raymond et Cestan: Sur un nouveau cas de paralysie des mouvements de lateralité des globes oculaires, Rev. neurol. 1903, p. 644.

† * Raymond et Cestan: Trois observations de paralysie des mouvements associés des globes oculaires, Rev. neurol. **9**:70, 1901.

* Raymond et Cestan: Paralysies associés des muscles des yeux, Ann. d'Oculistique **125**:197, 1901.

118. Raymond et Claude: Sur quelques symptoms des tumeurs de la protubérance, L'Encephale **1**:264, 1908.

119. Raymond et Rose: Syndrome de la calotte protubérantielle, Rev. neurol. **16**:265, 1908.

120. Redlich: Demonstration eines Falles den er als Tuberkel im Pons diagnostiziert, Wien. klin. Wchnschr. **13**:97, 1900.

121. * d'Astros (from Rickard's service) quoted by Peltier: Pathologie du pédoncule cérébrale, Rev. de méd. **14**:1, 97, 1894.

122. Righetti: Sur un cas de syndrome de la calotte mésencéphalique avec considerations sur la paralysie des mouvements associés de latéralité des globes oculaires, Riv. di patol. nerv. **12**:273, 1907; Rev. neurol. **17**:1, 187, 1909.

123. * Rohmer: Un cas d'hémiplégie oculaire (paralysie des mouvements associés de latéralité) Bull. et mem. de la Soc. franc. d'Ophth. **27**:243, 1910; Rev. neurol. **23**:346, 1912.

124. * Rohmer et Hoche: Paralysie des mouvements associés de latéralité vers la gauche, Rev. med. de l'Est. **42**:497, 1910; Rev. neurol. **21**:29, 1911.

125. † * Schoeler, F.: Beiträge zu den tuberkulösen Erkrankungen des Pons, Klin. monatsbl. f. Augenheilk. **40**:313, 1902.

126. Schoenherd: Case of Paralysis of Associated Lateral Movements of the Eyeballs, Arch. of Ophth. **48**:482, 1919.

127. † * Seggel: Doppelseitige abducens- und seitliche Blicklähmung, München. med. Wchnschr. **50**:772, 1903.

128. Senator: Affektion des Pons mit Erscheinungen von Tabes, Berl. klin. Wchnschr. **27**:41, 1890.

129. * Siemerling: Zur Syphilis des Centralnervensystems, Arch. f. psychiat. u. Nervenkr. **22**:191, 1890.

Siemerling: Ueber die chronische progressive Lähmung der Augenmuskeln, Arch. f. Psychiat. u. Nervenkr., Supplement **22**:1-206, 1891.

130. Smith, Priestley: A Case of Conjugate Deviation of the Eyes, Ophth. Hosp. Repts. **8**:185, 1876.

Smith: Bilateral Deviation of the Eyes, ibid. **9**:22, 1876.

131. † * Spiller: See reference 29.

* Spiller: Remarks on Lateral Oculogyration and on the Lesion Causing Complete Bilateral Ophthalmoplegia, Am. J. Med. Sc. **157**:695, 1919.

132. † * Spitzer, A.: Ein Fall von Tumor am Boden der Rautengrube, Obersteiner's Arbeiten **6**:1, 1899.

133. Steinert, H.: Zwei Fälle von Ponserkrankung, München. med Wchnschr. **36**:1548, 1903.

134. Thomas: Recherches sur la faisceau longitudinal posterieur, Rev. neurol. **11**:94, 1903.

135. * Thompson, Johnson and Ferrier: Given by Bleuler, p. 566. No reference to original.

136. * Touche: Hemiplégie syphilitique protubérantielle au cours du tabes, Soc. méd. des hôp. Ser. 3, **19**:213, 1902.

* Touche: Hémorrhagie protubôrantielle, ibid., p. 372.

137. Uhthoff: Untersuchungen über die bei der multiplen Herdsklerose vorkommenden Augenstörungen, Arch. f. Psychiat. und Nervenheilk. **21**:379, 1889-1890.

* Uhthoff: Demonstration von Präparaten eines Falles von Solitärtuberkel in der Medulla oblongata bei einem 3 jähr. Kinde. Tagebl. d. 59 Versamml. deutsch. Naturf. u. Aerzte. in Berlin, 1886.

138. * Urbantschitsch, E.: Linkseitiger Kleinhirnabscess bei einem 8 jährigen Kinde mit kompressorischem Verschluss des Foramen Magendie, Parese des linken Abducens u. rechten Internus. Monatschr. f. Ohrenheilk. **49**:736, 1915.

139. † * Wernicke: Ein Fall von Ponserkrankung, Arch. f. Psychiat. u. Nervenkr. **7**:513, 1877.

140. * Wernicke: Ueber einen Fall von Hirntumor, Deutsch. med. Wchnschr. **17**:85 and 101, 1880.

Wernicke: Ueber Lähmung der Seitwärtswender, Arch. f. Augenheilk. **42**: 183, 1901.

Wernicke: On Paralysis of Lateroversion, Arch. of Ophth. **32**:163, 1903; translated from Vol. 41, 1900, of the German edition.

141. * Wierzma: Een tumor in de pons, Psychiat. en neurol. Bladen. **6**:693, 1899; Ref. Neurol. Centbl. **19**:728, 1900.

142. * Winkler: Zeldzame gevallen van Epilepsie, Psychiat. en Neurol. Bladen, No. 3, 4, pp. 214, 321, 1897. Given by Uhthoff in Graefe-Saemisch Handbuch. See reference 10.

CHEMICAL INVESTIGATIONS OF THE CENTRAL NERVOUS SYSTEM UNDER NORMAL AND PATHOLOGIC CONDITIONS

CHEMICAL EXAMINATION OF THE CENTRAL NERVOUS SYSTEM IN TWO CASES OF GENERAL PARALYSIS

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INTRODUCTION

For a study of the chemical changes in the central nervous system in pathologic conditions, general paralysis was chosen because these cases show, both macroscopically and microscopically, perhaps the greatest amount of change and a chemical examination should, therefore, indicate the greatest variation from normal, if such variations can be demonstrated by chemical methods.

Data dealing with the influence or effect of disease on the chemical constituents of the nervous system are still very meager. None of the older investigators made any attempts at a quantitative study of changes in the chemical composition of nerve tissue under pathologic conditions except to determine the percentage of water and very often also the total amount of phosphorus. That much of the earlier work on the chemistry of pathologic nerve tissue is so incomplete was due to a lack of knowledge of the substances to be estimated so that a more accurate comparative study of normal and pathologic material could be made. Following Thudichum's [1] extensive studies of the different constituents in the brain a new interest was awakened in the chemical study of the nervous system. We can, however, mention only two of the more recent methods which in any way permit us to make a more systematic quantitative chemical study of the nervous system under normal and pathologic conditions. These are the methods of Siegmund Fraenkel [2] and Waldemar Koch.[3] A brief description of these methods follows:

METHODS

The method of Fraenkel consists in the study of the fat-like substances known as lipoids, separating these from one another by taking advantage of the fact that certain lipoids are more readily soluble in some of the fat solvents than in others. By successively extracting brain tissue with acetone, petroleum-

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1. Thudichum, J. L. W.: Die chemische Constitution des Gehirns des Menschen und der Tiere, Tübingen, 1901.

2. Fraenkel, S.: Gehirnchemie, Ergebn. d. Physiologie, 1909, vol. 8.

3. Koch, W.: Methods for the Quantitative Chemical Analysis of Animal Tissue, J. Am. Chem. Soc. **31**:1329, 1909.

ether, benzol, alcohol and ether, different lipoid groups were removed, leaving behind a protein residue. These different lipoid groups are classified under the different solvents used for their extraction. This method has been developed and extensively used by Fraenkel and his associates for the study of brain tissue. Recently Pighini [4] and his co-workers have employed this method with some success for the study of chemical changes in the whole brain in a number of cases of general paralysis.

The method of Koch consists in the study of the three large chemical fractions or groups: proteins, extractives and lipoids. By first extracting the fresh brain material with 85 per cent. alcohol and with water, the extractives and lipoids are removed, leaving behind a protein residue. The lipoids are then separated from the extractives by precipitating the former in a watery emulsion of the total extract, with chloroform in the presence of acid (hydrochloric). The individual lipoids are then determined either directly or by calculation from some element or chemical radical characteristic of each individual lipoid. In each of these three main groups the elements sulphur, phosphorus and nitrogen are determined. W. Koch employed and developed this method for the study of the mammalian nervous system during its growth and development (in man [5] and in the Albino rat [6]), also for the study of the adult brain in certain forms of insanity.[7] This method was employed for the investigation reported in this paper. (An explanation of the different groups is given on page 222).

Besides these two methods there are still two others which, while not representing as complete an analysis, have been applied to the chemical study of the brain in general paralysis, and should therefore be mentioned here.

The one is the method of Smith and Mair,[8] which consists in fixing brain material in formaldehyd, drying at 37 C. to constant weight, then extracting with chloroform and further separating different lipoids by saponifying the extract with hot acetone and then determining these directly. By this method the total extract appears low, as compared with the total extract of Fraenkel and of Koch. A comparative study of changes in pathologic nerve tissue by this method with that of the other methods is thereby limited.

Another method is that of Nelson [9] which follows the general plan employed by W. Koch, that is, dividing nerve tissue into three large fractions or groups: proteins, extractives and lipoids. It differs from Koch's method, however, in that the further separation of the extract into lipoids and extractives is carried out by refrigerating the extract fraction at 0 C. when the lipoids separate out, leaving the extractives in solution. Nelson does not determine individual lipoids. In each of the three main groups the elements sulphur, phosphorus and nitrogen are also determined. Nelson determined nucleic acid, protagon and neurokeratin.

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[4] Pighini, G.: Chemische u. biochemische Untersuchungen ueber das Nervensystem unter normalen u. pathologischen Bedingungen. IV. Beitrag zur chemischen Zusammensetzung des Gehirns bei der progressiven Paralyse (Carbone, D., und Pighini, G.), Biochem Ztschr. **46**:450, 1912.

[5] Koch, W., and Mann, S. A.: A Comparison of the Chemical Composition of Three Human Brains at Different Ages, J. Physiol. **36**:1, 1907.

[6] Koch, W., and Koch, M. L.: Contributions to the Chemical Differentiation of the Central Nervous System. III. The Chemical Differentiation of the Brain of the Albino Rat During Growth, J. Biol. Chem. **15**:423, 1913.

[7] Koch, W., and Mann, S. A.: A Chemical Study of the Brain in Healthy and Diseased Conditions with Especial Reference to Dementia Praecox, Arch. Neurol. & Psychiat. **4**:174, 1909.

[8] Smith, J. L., and Mair, W.: On a Method of Quantitative Analysis of Tissue Lipoids with a Preliminary Note on Degeneration in the Brain, J. Path. & Bacteriol. **16**:131, 1911.

[9] Nelson, Bert E.: Chemical Studies on the Central Nervous System, Psychiat. Bull. of the New York State Hospitals **9**:368,. 1916.

A comparison of these four methods indicates that the underlying principle is, generally speaking, similar; that is, each method aims to extract the lipoids from nerve tissue by means of fat solvents, leaving behind a protein residue. The solvents used and the technic employed for the separation and determination of the individual lipoids differs in each of these methods, however, and for greater detail and a clearer understanding of these methods the original articles should be consulted.

The extractives, or water soluble fraction, determined by W. Koch and also by Nelson have been almost entirely ignored by other investigators or only indirectly determined by Fraenkel. In normal adult nerve tissue this fraction is found to be constant, standing in a definite relation to the other chemical groups in the whole brain, as well as being definite in amount in each of the parts of the central nervous system studied. In view of this fact and because it is in this fraction that the intermediary and end products of nerve tissue metabolism are to be found, we feel justified in paying particular attention to this group.

The study of the distribution of the elements sulphur, phosphorus and nitrogen in nerve tissue has also received little attention. By studying the variations in the distribution of these elements in the three main groups we hope to show additional changes which have occurred under pathologic conditions, but which cannot otherwise be detected at the present time. These elements represent certain compounds in nerve tissue for which no quantitative determination has been made as yet.[10]

The chemical investigations of the nervous system in general paralysis have thus far been confined by different investigators to the whole brain. In the present investigation the analyses of an entire cerebral hemiphere (cerebrum[11]), corpus callosum, cortex, cerebellum and spinal cord in two cases of general paralysis are recorded. The object of analyzing the different parts of the central nervous system in general paralysis was to determine whether in this disease any special part of the brain undergoes greater changes than other parts.

SUBSTANCES IN THE NERVOUS SYSTEM

Our present knowledge permits us to refer to only certain groups of substances in the nervous system which may be arranged under the following general headings

1. Water.
2. Proteins: neurokeratin, nucleoproteins, globulins.

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[10] The lipoid-phosphorus has been used for the calculation of the "phosphatides" and the lipoid-sulphur for the calculation of the "sulphatides."

[11] The analysis of the "cerebrum" represents an analysis of one entire cerebral hemisphere while that of the cortex and corpus callosum represents an analysis of the gray and white matter collected from the other hemisphere.

3. Lipoids: cholesterol, phosphatides, cerebrosides, sulphatides.

4. Extractives: organic extractives such as the nonprotein nitrogen substances, neutral-sulphur, etc., and inorganic salts, ash.

The chemical constituents of the normal adult human brain[11a] consist of: (1) water, 77 per cent.; the solids, which consist of (2) proteins, that is, the residue from alcohol and water extraction; (3) lipoids, alcohol-soluble and water insoluble, and (4) extractives, alcohol and water soluble. The lipoids are further subdivided into three groups: (*a*) cholesterol, (*b*) unsaturated lipoids (phosphatids), and (*c*) saturated lipoids (cerebrosids and sulphatids). These groups represent the different chemical constituents in nerve tissue as adopted by W. Koch and in the main also by Fraenkel and are the groups used in this study to determine the chemical changes in the central nervous system in general paralysis. The second and third groups are colloidal in nature, and the fourth group is in the main noncolloidal.

The properties of these constituents or groups are in brief as follows:

Water.—This is the most abundant element of protoplasm and has the property, so important for the cell, of accelerating all kinds of chemical reactions. In nerve tissue the percentage of water is an index of age as well as being definite in amount in different parts of the normal adult nervous system. A change in water content may therefore be looked on as an index of chemical changes in the tissues, and if increased above normal in the adult, it usually indicates a pathologic condition.

Proteins.—These make up about 38 per cent. of the solids. It is not possible to tell at the present time to what extent these are involved in the chemical activities of the nervous system as they have been too little studied. As a group, however, their decrease is an index of age. They are definite in amount in different parts of the normal adult nervous system.

Lipoids.—These make up about 54 per cent. of the solids. When one considers that under normal conditions the brain is one of the tissues richest in these fat-like substances, it is possible to think of the brain as having an active lipoid metabolism, especially when one considers that almost one half of these lipoids consist of unsaturated lipoids (phosphatids). Under normal conditions these phosphatids are probably in a state of unstable chemical equilibrium constantly breaking down and constantly being built up again. They are capable of auto-oxidation and when oxidized have a greater affinity for water than when unoxidized (Mathews [12]). The saturated lipoids (cerebrosids and sulphatids), according to Mathews, have this same property of taking up water or combining with it, although possibly to a less extent. This is not true of cholesterol, however. (Besides these lipoids there are others less well defined; however, these are present only in small amounts which need not be considered in connection with this study.)

[11a] A more detailed description of the chemistry, anatomic distribution and physiologic significance of these different groups is given in the article by W. Koch and M. L. Koch referred to in footnote 6.

In nerve tissue the lipoids probably play an important rôle in conditioning the physical state of protoplasm. They are said to be in physical-chemical equilibrium with the proteins and with each other. According to Mathews,[13] and others, the function of the phosphatids is undoubtedly to produce with cholesterol the peculiar semifluid, semisolid state of protoplasm.

Extractives.—These make up about 8 per cent. of the solids. These represent the water-soluble constituents which include intermediary oxidation products and the larger part of the inorganic salts. The rôle played by these water-soluble extractives is probably very important in the chemical reactions of protoplasm. According to W. Koch,[6] this group as a whole is a rough index of the amount of metabolic activity going on in the tissues, as it represents at the same time the end-products of chemical activity as well as the culture mediums from which the more complex combinations are built up. In regard to this group Mathews [14] says: "It is very difficult to know whether these substances are normal constituents of the living brain, or whether they are formed by the hydrolytic decompositions which begin as soon as the circulation of the brain is interrupted." He believes, however, that "they pre-exist in the brain and that their accumulation there after death is due to the persistence of the vital processes in the absence of blood supply to remove the waste products. This view is supported by the relatively slight autolytic decomposition which brain material shows." [15]

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[12] Mathews, A. P.: Physiological Chemistry, Ed. 2, New York, William Wood & Co., 1916, p. 98.

[13] Mathews, A. P.: Physiological Chemistry, p. 88.

[14] Mathews, A. P.: Physiological Chemistry, p. 579.

[15] From a comparative chemical study on brains collected from one to thirty hours after death (kept in cold chamber), W. Koch concluded that the variations found are of little significance. He says, "The results are in harmony with other observations which indicate a very slow rate of autolysis in the brain. Nevertheless the material should be collected within twenty-four hours after death if possible."

A comparison of the chemical composition of brains from Albino rats dying during the night and of whom a necropsy examination was made the next morning, with brains from freshly killed (chloroformed) Albino rats of whom a necropsy examination was made immediately, showed no differences except those which could be attributed to differences in the age of the animals. The conclusion is therefore drawn that autolytic decomposition plays little, if any, part in influencing the chemical composition of the extractives.

Very few of these brain extractives have been isolated or identified as yet. The organic extractive group contains the nonprotein nitrogen substances, such as urea, amino acids, ammonia and creatinin, also the neutral sulphur. The inorganic salts consist largely of sodium, potassium, calcium, magnesium, chlorid, sulphate and phosphate. Some of these have been studied by W. Koch,[16] and more recently Clowes [17] has pointed out that the inorganic salts or "electrolytes" appear to play an extremely important rôle in conditioning the form and structure and in maintaining the equilibrium of the complex colloidal system which is designated as living protoplasm. The principal reason for reporting this group at the present time is to determine the ratio between these noncolloidal water-soluble constituents and the colloidal constituents (proteins and lipoids) in nerve tissue.

In general, we find, therefore, that we are dealing with group reactions in which the proteins and lipoids are classed as colloidal and have possibly a structural value while the extractives or noncolloidals represent the circulating material in the cell.

PRESENTATION OF CHEMICAL DATA

The two cases chosen for this study were those in which clinical diagnosis of general paralysis was given (for case histories see end of paper).[18] The results of the chemical analyses of these two cases are summarized in Tables 1, 2, 3, 4 and 5.[19]

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[16] Koch, W.: Die Bedeutung der Phosphatide (Lecithane) für die lebende Zelle. II. Mitteilung, Ztschr. f. phys. Chemie **63**:432, 1909. Koch, W., and Pike, F. H.: Pharmacological Studies of the Phosphatides, J. Pharm. & Exper. Therap. **2**:245, 1910. Koch, W., and Williams, A. W.: Ibid., p. 251.

[17] Clowes, G. H. A.: Antagonistic Electrolyte Effects in Physical and Biological Systems, Science **43**:750, 1916.

[18] For controls are given two normal cases of cerebrum and cerebellum and four normal cases of spinal cord, all of which were recently analyzed by myself (Koch, M. L., and Voegtlin, C.: Hygienic Lab. Bull. No. 103, 1916, p. 51). The figures for the normal corpus callosum and normal cortex are from analyses made by W. Koch, published in connection with his chemical studies on the central nervous system.

[19] In making a comparison between the values reported in the tables a definite plan has been followed. The values of normal cases are used as a standard with which the values obtained in general paralysis are compared. The *percentage difference* between the observed percentage values has been determined in each instance and the interpretation of the findings are based on these.

Values which vary from the normal by less than 10 per cent. are considered normal or said to show a tendency either to increase or decrease. Values varying from 10 to 20 per cent. are considered to be slightly different—slightly increased or slightly decreased. Those varying from 20 to 30 per cent. are considered to be different—increased or decreased. Those varying above 30 per cent. are considered to be greatly increased or greatly decreased. (The distinctions noted have been carefully maintained in interpreting the figures in the tables.)

TABLE 1.—COMPARISON OF THE CEREBRUM, CEREBELLUM AND SPINAL CORD IN NORMAL PERSONS WITH THOSE OF TWO PATIENTS WITH GENERAL PARALYSIS (KOCH)

	Relative Proportions of Constituents in Percentage of Solids																
	Cerebrum					Cerebellum					Spinal Cord						
	Normal*			General Paralysis		Normal*			General Paralysis		Normal*					General Paralysis	
			Aver.	I	II			Aver.	I	II					Aver.	I	II
1. Percentage of water	77.1	76.6	76.9	77.82	79.19	78.60	77.66	78.13	78.18	77.26	70.34	71.46	71.16	73.43	71.60	72.66	72.09
Percentage of solids	22.9	23.4	23.1	22.18	20.81	21.40	22.34	21.87	21.82	22.74	29.66	28.55	28.84	26.57	28.40	27.34	27.91
2. Protein residue	37.63	37.90	37.76	38.48	37.93	40.04	40.67	40.35	42.73	44.10	29.00	30.56	28.17	30.60	29.60	30.87	35.12
Extractives	7.98	7.76	7.87	14.52	15.22	10.41	7.04	8.72	11.46	14.98	5.70	5.61	5.77	5.24	5.60	6.46	9.035
Lipoids	54.39	54.34	54.37	47.00	46.85	49.55	52.29	50.92	45.81	40.92	65.30	63.83	66.06	64.16	64.80	62.67	55.85
3. (a) Cholesterol	10.93	9.34	10.03	8.71	8.504	7.23	5.60	6.41	7.19	7.987	11.64	12.84	10.12	12.58	11.79	15.08	13.58
(b) Phosphatids	28.54	28.13	28.33	22.74	25.33	25.64	24.33	24.98	23.76	22.85	27.45	29.80	31.80	31.13	30.05	30.96	28.15
(c) Cerebrosids	7.25	6.04	6.64	7.38	8.57	9.41	5.34	7.37	7.22	6.63	11.57	12.38	.....	11.80	11.91	12.22	
Sulphatids	9.73	9.58	9.65	9.43	11.78	8.27	9.70	8.98	5.35	6.59	12.60	11.27	13.40	12.11	12.34	9.66	8.96

* Koch, M. L., and Voegtlin, C.: Footnote 18.

TABLE 2.—COMPARISON OF NORMAL CORPUS CALLOSUM (FIVE CASES) AND CORTEX (THREE CASES) WITH TWO CASES OF GENERAL PARALYSIS (KOCH)

	Relative Proportion of Constituents in Percentage of Solids													
	Corpus Callosum (White Matter)								Cortex (Gray Matter)					
	Normal†						General Paralysis		Normal†				General Paralysis	
	(a)	(b)	(c)	(d)	(e)	Aver.	I	II	(a)	(c)	(d)	Aver.	I	II
1. Percentage of water	68.0	70.0	.....	69.70	70.31	69.50	.72.38	70.99	82.0	....	83.2	82.6	84.10	82.20
Percentage of solids	32.0	30.0	.....	30.30	29.69	30.50	27.62	29.01	18.0	....	16.8	17.4	15.90	17.80
2. Protein residue	29.96	28.10	28.70	27.1	29.25	28.62	30.42	30.29	46.6	45.7	47.1	46.4	49.38	52.50
Extractives	4.75	5.80	6.10	6.30	5.12	5.61	7.07	7.464	(8.8)	13.2	15.4	14.3	19.90	19.38
Lipoids	65.29	66.10	65.2	66.5	65.63	65.64	62.51	62.25	....	41.1	37.5	39.3	30.72	28.12
3. (a) Cholesterol	15.2*	.....	.....	10.25*	.....	12.72	15.83	14.53	3.9*	....	4.9*	4.4	5.26	3.724
(b) Phosphatids	27.13	(22.10)	27.90	31.0	27.63	28.41	29.75	25.67	21.6	24.5	23.7	23.2	19.41	17.00
(c) Cerebrosids	14.3	17.1	17.7	18.30	.....	16.85	13.13	13.30	8.6	7.9	8.8	8.4	(2.55)*	(2.88)*
Sulphatids	4.37	7.30	4.7	8.65	7.46	6.50	12.66	10.91	8.0	(....)	(....)	8.0	3.50	3.40

* By difference. † Koch, W.: Footnote 18.

The figures given in Table 3 represent the percentage variation from normal, that is, the percentage value of the difference between the several observed percentages in Tables 1 and 2.

TABLE 3.—Deviations of Percentages in Brains of Patients With General Paralysis Based on Tables 1 and 2

		Water		Proteins		Extractives		Lipoids	
		Case I	Case II	Case I	Case II	Case I	Case II	Case I	Case II
1 and 2	Cerebrum	+ 1	+ 3	+ 2	0	+84	+93	−13	−14
	Cortex	+ 1	0	+ 7	+13	+39	+35	−21	−28
	Corpus callosum	+ 4	+ 2	+ 6	+ 5	+26	+23	− 5	− 5
	Cerebellum	0	0	+ 3	+ 8	+31	+74	−12	−19
	Spinal cord	0	0	+ 4	+18	+15	+61	− 2	−13
		Cholesterol		Phosphatids		Cerebrosids		Sulphatids	
		Case I	Case II	Case I	Case II	Case I	Case II	Case I	Case II
3	Cerebrum	−13	−15	−12	−10	+11	+29	− 2	+22
	Cortex	+24	−15	−16	−26	....	....	−56	−57
	Corpus callosum	+20	+22	+ 4	−10	−20	−18	+94	+67
	Cerebellum	+12	+24	− 5	− 9	− 2	−10	−40	−26
	Spinal cord	+27	+15	+ 3	− 9	+ 2	....	−21	−27

1.[20] Water is normal or shows a tendency to increase. This increase in water is accompanied by a proportionate decrease in solids.

2. Proteins, that is, residue from alcohol and water extraction, were practically normal or showed only a tendency to increase.

Extractives, alcohol and water soluble, are greatly increased; the most pronounced change is in the cerebrum in both cases.

Lipoids, alcohol soluble and water insoluble, are either slightly decreased or decreased in all five parts in both cases; the most pronounced in the cortex; the least pronounced in the corpus callosum where these show only a tendency to decrease.

3. (*a*) Cholesterol appears to be increased in all parts except in the cerebrum, where it is slightly decreased. Percentage variations of cholesterol in the corpus callosum and cortex are not strictly comparable since this was not determined directly in the normal person.

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[20] These numbers refer to numbers in the tables which indicate different divisions into which the chemical groups have been divided in order to obtain a closer correlation between the chemical findings of the different investigators. For example, division 1 comprises water and solids; division 2, protein residue. extractives and lipoids; division 3, (*a*) cholesterol, (*b*) unsaturated lipoids (phosphatids), (*c*) saturated lipoids (cerebrosids and sulphatids); division 4, protein sulphur, lipoid sulphur, neutral sulphur, inorganic sulphur and total sulphur; division 5, protein phosphorus, lipoid phosphorus, extractive phosphorus and total phosphorus; and division 6, protein nitrogen, lipoid nitrogen, extractive nitrogen and total nitrogen.

(*b*) Phosphatids are slightly decreased in the cerebrum and in the cortex; in the other three parts these show a slight tendency to decrease.

(*c*) Cerebrosids are slightly increased in the cerebrum but in the corpus callosum they are slightly decreased. In the cerebellum and spinal cord these appear to be normal.

(Percentage variation of cerebrosids in the cortex could not be compared since these were not determined in these general paralytic brains.)

(*d*) Sulphatids are greatly increased in the corpus callosum; normal in the cerebrum of Case 1 and increased in the cerebrum of Case 2. The sulphatids in the other three parts were greatly decreased.

In Table 4 the distribution of sulphur, phosphorus and nitrogen calculated in percentage of total sulphur, total phosphorus and total nitrogen in the three chemical fractions (proteins, extractives and lipoids) is compared in the cerebrum, cerebellum and spinal cord. We find that in the protein fraction all three elements are practically normal —the sulphur and phosphorus showing only a tendency to increase (with the exception of the protein-phosphorus in the spinal cord of the patient in Case 1 in whom this is decreased), the nitrogen showing a tendency to decrease. In the lipoid fraction the sulphur is practically normal in the cerebrum, greatly decreased in the cerebellum and decreased in the spinal cord; the phosphorus and nitrogen are decreased in the three parts, mostly in the cerebrum. In the extractive fraction the neutral-sulphur is practically normal in the cerebrum, greatly increased in the cerebellum and possibly also in the spinal cord; the inorganic sulphur is normal in the cerebrum, greatly decreased in the cerebellum and greatly increased in the spinal cord; the extractive-phosphorus and extractive-nitrogen are greatly increased in all three parts. Total sulphur, total phosphorus and total nitrogen are practically normal.

In Table 5 the distribution of the elements sulphur and phosphorus in the corpus callosum and cortex are compared, calculated in percentage of total sulphur and total phosphorus (nitrogen had not been determined in the normal corpus callosum and cortex and could therefore not be compared here). Since the normal values for these two parts are obtained by older methods which are not altogether comparable with the methods in use at the present time, it is not possible to make a comparison with the same degree of confidence as was done in the other three parts. We can place most reliance on the figures for the lipoid phosphorus which we find to be greatly decreased in the cortex—even more than in the cerebrum—while this is little changed in the corpus callosum.

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TABLE 4.—COMPARISON OF CEREBRUM, CEREBELLUM AND SPINAL CORD OF NORMAL PERSONS WITH THOSE OF TWO PATIENTS WITH GENERAL PARALYSIS (KOCH)

	Distribution of Sulphur, Phosphorus, and Nitrogen in Percentage of Total Sulphur, Total Phosphorus and Total Nitrogen																
	Cerebrum					Cerebellum					Spinal Cord						
	Normal*			General Paralysis		Normal*			General Paralysis		Normal*					General Paralysis	
			Aver.	I	II			Aver.	I	II					Aver.	I	II
4. Protein sulphur	59.30	58.20	58.74	62.02	60.23	61.10	60.64	60.87	71.27	65.40	47.20	42.38	46.60	42.63	44.70	49.65	51.04
Lipoid sulphur	30.04	31.01	30.53	27.11	29.05	28.62	29.22	28.92	17.89	18.40	42.87	43.82	43.30	46.65	44.16	37.50	29.68
Neutral sulphur	8.68	9.39	9.04	8.97	9.92	6.91	4.48	5.69	7.84	12.95	6.73	10.50	7.30	7.42	7.99	(2.15)	10.31
Inorganic sulphur	1.98	1.40	1.69	1.90	0.80	3.37	5.66	4.51	3.00	3.25	3.20	3.30	2.80	3.30	3.15	10.7	8.97
Total sulphur (in per cent. of total solids)	0.647	0.617	0.632	0.704	0.756	0.578	0.662	0.620	0.597	0.716	0.580	0.514	0.609	0.519	0.555	0.515	0.604
5. Protein phosphorus	12.11	11.00	11.56	13.10	13.17	20.91	19.00	19.95	21.74	21.49	11.09	10.10	10.32	11.39	10.72	8.39	10.65
Lipoid phosphorus	74.96	75.16	75.06	64.40	67.50	67.84	66.50	67.17	61.01	56.60	82.06	83.20	85.33	82.45	83.26	82.56	77.62
Extractive phosphorus	12.93	13.84	13.38	22.47	19.32	11.25	14.50	12.87	17.25	21.91	6.85	6.70	4.35	6.17	6.02	9.05	11.71
Total phosphorus (in per cent. of total sodids)	1.44	1.45	1.45	1.37	1.456	1.46	1.42	1.44	1.511	1.56	1.30	1.39	1.45	1.43	1.39	1.44	1.407
6. Protein nitrogen	80.00	79.53	79.78	76.96	74.30	80.83	80.32	80.58	80.45	80.20	.....	75.34	.....	.....	75.34	73.24	(75.56)
Lipoid nitrogen	11.80	10.53	11.16	8.90	7.40	11.21	10.42	10.81	9.70	8.87	.....	20.17	.....	.....	20.17	17.23	(10.28)
Extractive nitrogen	8.02	9.91	8.96	14.14	18.30	7.96	9.26	8.61	9.85	10.93	.....	4.49	.....	.....	4.49	9.53	(14.16)
Total nitrogen (in per cent. of total solids)	7.697	7.180	7.44	7.16	8.69	8.407	7.764	8.085	7.74	8.09	.....	6.81	.....	.....	6.81	6.31	6.91

* Koch, M. L., and Voegtlin, C.: Footnote 18.

TABLE 5.—COMPARISON OF NORMAL CORPUS CALLOSUM (THREE CASES) AND CORTEX (TWO CASES) WITH TWO CASES OF GENERAL PARALYSIS (KOCH)

	Distribution of Sulphur and Phosphorus in Percentage of Total Sulphur and Total Phosphorus										
	Corpus Callosum (White Matter)						Cortex (Gray Matter)				
	Normal†				General Paralysis		Normal†			General Paralysis	
	(d)	(f)	(e)	Aver.	I	II	(d)	(f)	Aver.	I	II
4. Protein sulphur	56.0	54.1	53.8	54.6	51.0	54.5	76.5	75.2	75.8	73.4	58.7‡
Lipoid sulphur	36.0	35.9	32.4	34.8	40.9	34.1	7.0	7.1	7.1	9.8	8.7
Neutral sulphur	5.0	6.5	7.5	6.3	6.3	9.3	10.0	12.2	11.1	16.8	26.8‡
Inorganic sulphur	3.0	3.5	6.2	4.2	1.8	2.1	6.5	5.5	6.0		5.8
Total sulphur (in per cent. of solids)	0.50	...	0.50	0.50	0.62	0.64	0.46	...	0.46	0.71	0.78
5. Protein phosphorus	5.0*	.....	12.4	12.4	10.6	12.3	5.0	.....	5.0	17.1	19.4
Lipoid phosphorus	81.0*	.....	75.8	75.8	77.7	75.7	63.00	.....	63.0	56.3	47.5
Extractive phosphorus	15.0*	.....	11.80	11.80	11.7	12.0	32.0	.....	32.0	26.6	33.1
Total phosphorus (in per cent. of solids)	1.45	.....	1.42	1.43	1.42	1.32	1.45	.....	1.45	1.34	1.39

* Older method. ‡ Doubtful. † Koch, W.: Footnote 18.

The ratio of the protein sulphur to the neutral sulphur has been found to be a means of investigating protein metabolism in the central nervous system during its growth period.[21] In certain forms of mental disorder, this ratio was found changed in the cerebrum as indicated in Table 6.

In cases of dementia praecox for example this ratio was found to be greatly changed, due to the great decrease in the neutral sulphur. W. Koch reached the tentative conclusion that "in dementia praecox there exists a condition of metabolic deficiency." In pellagra a similar change was observed although less marked. It is therefore of interest to find that in general paralysis this ratio of protein sulphur to neutral sulphur is close to normal, which leads one to believe that changes in this disease point less toward a condition of "metabolic deficiency" and more toward a destruction of tissue as indicated by the decrease of the lipoid phosphorus and lipoid nitrogen.

TABLE 6.—Ratio of Protein Sulphur to Neutral Sulphur

	Protein Sulphur	Neutral Sulphur
Normal (average of 5)	58.8	8.9
Dementia praecox* (average of 5)	64.5	5.2
Pellagra† (average of 5)	65.5	7.2
General paralysis (Case I)	62.0	9.0
General paralysis (Case II)	60.2	9.9

* Koch, W.: Chemical Study of the Brain in Cases of Dementia Praecox, J. Exper. Med. 13:301, 1911.

In summing up the chemical findings in the central nervous system in these two cases of general paralysis we find that the water and proteins tend to increase while the lipoids as a whole tend to decrease. The most marked change, however, is the great increase of the extractives in consequence of which the relative proportions of the lipoid group to the extractive group have been changed. To what extent these two groups have been changed in absolute differences between the percentages as found in Tables 1 and 2, for the different parts of these pathologic brains, is indicated in the following:

The lipoids in the different parts were thus decreased: In Case 1: cerebrum, 7.4 per cent.; cortex, 5.5 per cent.; cerebellum, 5.1 per cent.; corpus callosum, 3.3 per cent.; spinal cord, 2.1 per cent. In Case 2: Cerebellum, 10 per cent.; spinal cord, 9 per cent.; cortex, 8.1 per cent.; cerebrum, 7.6 per cent.; corpus callosum, 3.6 per cent. The extractives in these parts were thus increased: In Case 1: cerebrum, 6.6 per cent.; cortex, 3.3 per cent.; cerebellum, 2.8 per cent.; spinal cord, 0.9 per cent.; corpus callosum, 0.6 per cent. In Case 2: cerebrum,

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[21] Koch, W.: Footnote 5. Koch, M. L.: Footnote 6.

7.3 per cent.; cerebellum, 6.3 per cent.; spinal cord, 4.3 per cent.; cortex, 2.8 per cent.; corpus callosum, 2 per cent.

Of the individual lipoids the cholesterol is either normal or increased; the unsaturated lipoids (phosphatids) are decreased; and of the saturated lipoids the cerebrosids are practically normal in all parts except in the cerebrum, where they are increased and in the corpus callosum where they are decreased; the sulphatids are practically normal in the cerebrum and decreased in all parts except the corpus callosum where they are greatly increased.

The three elements, sulphur, phosphorus and nitrogen, follow in a general way the three main groups, as, for example, in the protein fraction all three elements are practically normal; in the lipoid fraction these are decreased, especially the phosphorus and nitrogen; while in the extractive fraction these same elements are greatly increased. It is of interest to note that the phosphorus and nitrogen throughout show greater changes than the sulphur in the parts of the central nervous system studied. The ratio of the protein sulphur to neutral sulphur in the cerebrum was found to be practically normal.

The cerebrum shows consistent percentage variation from normal for the different groups, especially in the relative proportion of the lipoids to the extractives. The cortex shows perhaps greater percentage variation from normal than the corpus callosum, especially for the total lipoids and the phosphatids. The cerebellum and spnial cord show generally less changes than the cortex but more pronounced changes than the corpus callosum. The corpus callosum is apparently least affected.

Whereas the two patients show the same relative changes in the different parts of the central nervous system, the patient in Case 2 almost without exception shows more intensive changes than the patient in Case 1.

W. Koch [7] some years ago determined different chemical constituents in the cortex and corpus callosum of one general paralytic brain and the sulphur and phosphorus distribution in the three main chemical groups of four general paralytic brains. From a comparison of these findings of W. Koch which were determined by an older method, with those reported in this paper, it is found that these are similar, except for the extractives in the cortex, which W. Koch stated are decreased. Since, however, the percentage variation from normal is not more than — 11, which is only a slight decrease, this may be considered practically normal. The decreased lipoid phosphorus with the corresponding increase of the extractive phosphorus in the whole brain is in agreement with my findings for the cerebrum (Tables 2 and 3).

TABLE 7.—Comparison of the Chemical Composition of the Cortex and Corpus Callosum of One Normal Person With Those of One Patient With General Paralysis (Koch and Mann, Older Method)

	Relative Proportion of Constituents in Percentage of Solids			
	Cortex		Corpus Callosum	
	Case 15 Normal	Case 16 G. P.	Case 15 Normal	Case 16 G. P.
2. Proteins	47.1	50.7	27.1	30.0
Extractives*	9.5 }	7.6 }	3.9 }	3.7 }
Ash*	5.9 } 15.4	6.0 } 13.6	2.4 } 6.3	3.2 } 6.9
Lecithins and kephalins†	23.7	23.9	31.0	25.0
3. Cerebrins‡	8.8	9.4	18.3	18.2

* Extractives. † Phosphatids. ‡ Cerebrosids.

TABLE 8.—Comparison of the Chemical Composition of the Brains of Two Normal Persons and Those of Four Patients With General Paralysis (Koch and Mann)

	Distribution of Sulphur and Phosphorus in Percentage of Total Sulphur and of Total Phosphorus							
	Normal		General Paralysis				Averages	
	Case 18	Case 70	Case 22	Case 23	Case 24	Case 40	Normal	General Paralysis
4								
Protein sulphur	60.9	62.6	56.7	57.1	62.0	61.4	61.7	59 3
Lipoid sulphur	28.6	25.9	30.2	30.8	25.1	28.4	27.2	28.6
Neutral sulphur	7.2	8.1	9.3	8.3	9.1	6.4	7.7	8.3
Inorganic sulphur	3.3	3.4	....	3.7	....	....	3.4	3.7
Total sulphur in percentage of total solids	....	....	....	....	....	....	0.50	0.48
5								
Protein phosphorus	3.9	5.7	5.9	4.8	4.6	4.6	4.8	5.0
Lipoid phosphorus	71.8	75.0	69.3	70.6	68.2	69.9	73.4	69.5
Extractive phosphorus	24.2	19.4	24.7	24.7	26.9	25.6	21.8	25.5
Total phosphorus in percentage of total solids	....	....	....	....	....	....	1.45	1.46

Other chemical studies on the whole brain in general paralysis by different investigators may now be considered. In 1912, Pighini[4] reported the chemical findings in five cases and in 1914 he, together with Barbieri,[22] reported seven additional cases of general paralysis, two of which they also studied histochemically. The main chemical changes in general paralysis, as found by these investigators (Table 9), are

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[22] Pighini, G., and Barbieri, P.: Chemische und histochemische Untersuchungen über die lipoiden Abbaustoffe des Gehirns bei progressiver Paralyse, Ztschr. f. d. ges. Neurol. u. Psychiat., Orig. **25**:353, 1914.

TABLE 9.—COMPARISON OF THE BRAIN IN TWO NORMAL PERSONS WITH THOSE OF TWELVE PATIENTS WITH GENERAL PARALYSIS (FRAENKEL METHOD) BY PIGHINI AND BARBIERI

	Relative Proportion of Constituents in Percentage of Solids													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Normal		Year of Analysis, 1912					Year of Analysis, 1914						
			Age in Years					Age in Years						
			N. S. 52	L. C. 43	M. C. 49	E. B. 42	M. B. 47	G. S. 53	A. F. 41	L. B. 45	C. Q. 37	T. T. 31	L. M. 42	M. T. 40
1. Percentage of water	77.0	76.10	(83.0)	77.81	84.58	78.97	.....	80.83	78.88	82.77	82.29	79.80	77.91	77.20
Percentage of solids	23.0	23.90	(17.0)	22.19	15.42	21 03	.....	19.17	21.12	17.23	19.71	20.20	22.09	22.80
2. Protein residue	31.63	38.67	.....	41.94	.....	.....	.....	46.52	40.21	53.80	51.07	50.00	42.80	45.16
Extractive (including leukopolin, a phosphatid)	9.64	.....	(4.5)	.....	8.97	6.00	11.84	4.90	4.30	3.32	4.67	6.46	6.05	8.99
Lipoids	58.73	.....	.....	.....	.....	.....	.....	48.58	49.49	42.88	44.26	43.34	51.15	45.55
3. Acetone extract*	20.60	14.64	(26.71)	30.48	22.87	24.60	31.32	22.15	19.00	16.00	17.32	22.10	21.70	21.40
(a) Cholesterol (crude)	10.96	.....	(24.2)	.....	13.90	18.60	19.48	17.25	14.70	12.68	12.65	15.64	15.65	12.41
(b) Unsaturated lipoids extracted with pertoleum-ether†	27.836	28.85	(14.28)	12.33	23.14	13.93	11.23	17.76	25.50	20.03	13.45	15.39	26.40	18.16
(c) Saturated lipoids	20.70	17.84	.....	15.25	....	.....	.....	13.94	8.51	10.35	18.08	12.87	9.00	15.22
Extracted with benzol	13.53	12.27	.....	6.20	.....	.....	.....	9.03	5.55	6.00	14.58	9.37	2.09	11.49
Extracted with alcohol	6.258	4.46	.....	8.75	.....	.....	.....	3.68	2.46	4.35	3.50	3.13	6.80	3.73
Extracted with ether	0.92	1.11	.....	0.30	.....	.....	.....	0,23	0.50	....	....	0.37	0.11	....

* Sum of cholesterol and extractives.

† Phosphatid.

an increase in water, proteins and cholesterol and a decrease of the lipoids as a whole and the unsaturated lipoids (phosphatids) in particular, as well as the saturated lipoids (cerebrosids and sulphatids). The relative proportion of the different lipoid groups among themselves were reversed. As, for example, the acetone group consisting of cholesterol and extractives, was greatly increased in eight of the twelve cases so that this is now greater than the normally high petroleum-ether extract group, the latter representing the unsaturated lipoids. The other extracts—from benzol, alcohol and ether—representing the saturated lipoids, varied among themselves although with less consistency. These findings indicate, according to Pighini and Barbieri, that while all twelve paralytic brains have undergone changes, brains may be affected differently. These findings are in agreement with those of the cerebrum in the two paralytic cases of this study.

TABLE 10.—Comparison of Three Normal Brains With Those of Three Patients With General Paralysis and Two Patients With Hemiplegia (Smith and Mair) *

	2	3		5
	Chloroform Extract Percentage of Dried Brain	Cholesterol in Percentage of Extract	Cerebrosids in Percentage of Extract	Phosphorus in Percentage of Extract
Normal:				
Case 1 (peritonitis)	46	22.0† 20.3	20.7† 20.2	1.58
Case 2 (cerebral hemorrhage)	42	21.8	20.4 19.5	1.59
Case 3‡ (cerebral thrombosis, normal area)	51	21.4	18.1 17.8	1.60
General Paralysis:				
Case 1	38	18.0	10.0	1.22
Case 2	..	20.2 19.2	12.0 10.0	1.34
Case 3	43	20.0 20.4	10.2 11.5	1.31
Hemiplegia (degenerated areas):				
Case 1 (hemorrhage) 4 months' history	51	41.0 42.6	8.0 10.0	0.54
Case 2 (thrombosis) 3 weeks' history	43	29.6	4.8 4.5	1.23

* The table was reconstructed to include only comparable data.

† "In this table the bracketed figures indicate two analyses of the same material, and they are given in this form in order to indicate the accuracy of the methods for cholesterol and cerebrosids respectively."

‡ "Normal No. 3 and hemiplegia No. 2 are from the same brain, the normal area being taken from the unaffected hemisphere."

Smith and Mair,[8] who analyzed three normal and three general paralytic brains (Table 10), also found a loss of lipoids (chloroform extract) in pathologic brains. In percentage of this chloroform extract they found the cerebrosids greatly decreased, the cholesterol normal and the phosphorus, which represents the phosphatids, decreased. This is in agreement with our findings in the cerebrum with the exception of the great decrease of the cerebrosids. Two cases of hemiplegia are introduced in Table 10 for comparison.

Nelson [9] analyzed only one general paralytic brain (Table 11), and since he does not give any figures for the normal, the figures for the normal brain from Table 1 have been introduced in Table 11. In comparing Nelson's figures with these normal figures, one arrives at similar conclusions regarding changes in the brain in general paralysis. Nelson found water and proteins increased and the lipoids as a whole decreased. The extractives, according to Nelson, appear to show little change which is constant, but which, when compared with the normal figures in the table, show the extractives to be considerably increased in this one case, which would be in agreement with our findings. According to Nelson, these changes seem to produce nearly proportional changes in the amounts of protein phosphorus and protein nitrogen, while protein sulphur is only relatively increased, which he attributes to increased amounts of neurokeratin; the lipoid phosphorus is greatly decreased and to a less extent the lipoid nitrogen and the lipoid sulphur; the extractive phosphorus is practically normal, the extractive nitrogen is quite strongly increased and the extractive sulphur to a less degree. Total sulphur, phosphorus and nitrogen appear to be increased.

TABLE 11.—COMPARISON OF NORMAL BRAIN (AVERAGE OF TWO CASES; KOCH) WITH ONE CASE OF GENERAL PARALYSIS (NELSON)

		Normal Analyst, M. L. Koch	General Paralysis Analyst, B. E. Nelson
1.	Percentage of water	76.9	81.7
	Percentage of solids	23.1	18.3
		In Percentage of Solids	In Percentage of Solids
2.	Protein residue	37.76	50.75
	Extractives	7.87	10.83
	Lipoids*	54.37	38.42
3.	Nucleic acids	.....	0.32
	Protagon	.....	2.03
	Neurokeratin	.....	5.00
4.	Protein sulphur	0.372	0.683
	Lipoid sulphur	0.197	0.105
	Extractive sulphur	0.068	0.033
	Total sulphur	0.637	0.821
5.	Protein phosphorus	0.154	0.285
	Lipoid prosphorus	1.065	0.613
	Extractive phosphorus	0.225	0.205
	Total phosphorus	1.44	2.10
6.	Protein nitrogen	5.826	7.861
	Lipoid nitrogen	0.911	1.390
	Extractive nitrogen	0.701	2.550
	Total nitrogen	7.438	11.800

* Individual lipoids not determined.

DISCUSSION

From the data presented it is found that there are certain general changes of the brain in general paralysis. These changes are found in the whole brain as well as in its parts, the cerebrum showing perhaps the most consistent change throughout, the cortex showing a greater percentage variation from normal than the corpus callosum; the cerebellum and the spinal cord show perhaps less change than the cortex, but more pronounced than the corpus callosum. These changes are a slight increase in water (moisture) in the fresh tissue and in the solids a relative increase of proteins and possibly also cholesterol and a decrease of the lipoids as a whole. Of the latter, the unsaturated lipoids (phosphatids) showed the most consistent change (decrease); the saturated lipoids (cerebrosids and sulphatids) showed less consistent changes although as a group they probably also decrease (Table 9). Since proteins and cholesterol are practically normal when calculated in percentage of fresh tissue, these are probably only increased in percentage of solids is so far as the lipoids have decreased.

In the present investigation, in addition to these changes, there was found a marked increase in the extractives (water-soluble substances consisting of organic extractives and inorganic salts). The lipoid phosphorus and lipoid nitrogen were decreased while the extractive phosphorus and the extractive nitrogen were increased (Koch and Nelson).

From earlier work on degenerative diseases of the nervous system, chemical evidence of the breakdown of nervous tissue was obtained by the discovery of certain disintegration products in the spinal fluid and in the blood of patients. The determination of phosphorus constitutes one of the first attempts to study changes under pathologic conditions. Halliburton[23] and his co-workers who studied "phosphatid degeneration" in nerve tissue, claim that the phosphatid portion of the molecule is freed or liberated, leaving behind the "fatty portion of the molecule" which, according to them, gives the Marchi reaction. Besides phosphorus, which Halliburton and his co-workers found decreased in the tissue and increased in the blood, they studied nitrogen (by the cholin radical) and found by both chemical and physiologic tests that this was also increased in the blood of experimental animals in whom the nerve had been cut and allowed to degenerate for a certain number of days.

It is therefore possible to think of the less stable lipoids (unsaturated lipoids or phosphatids) as breaking down from their physical or physical-chemical combinations with the proteins and with other lipoids, with a subsequent appearance in the extractive fraction of some of the splitting products of simpler molecular composition. The decrease of the lipoid phosphorus and lipoid nitrogen fractions with the increase of the extractive phosphorus and extractive nitrogen fraction would indicate such a change.

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[23] Halliburton, W. D.: The Croonian Lectures on the Chemical Side of Nervous Activity, John Bale Sons and Danielson, Ltd., 1901.

Why cholesterol remains in the tissues or appears to be increased is not well understood. It has been suggested by Pighini and Barbieri that cholesterol acts as a protective agent in that it neutralizes the action of the syphilitic toxin. Since cholesterol, however, appears to be relatively inert chemically, its presence in the tissue is therefore probably only important to the cell from a physical or mechanical standpoint. It is present largely in the nerve sheaths to which it is supposed to add mechanical stability.

One would expect the saturated lipoids, which appear to be confined largely, although not entirely, to the white matter (corpus callosum) to correspond closely to this part of the nervous system or run more or less parallel to it in degree of change. This was found to be the case.

The chemical as well as the structural changes found in the brain of general paralysis are probably the result of autolytic processes. In cells undergoing autolysis, Wells[24] states that fat-like "myelin" droplets appear, and presumably represent cell lipoids set free through changes in the cell proteins. Wells goes on to say that these droplets "are characterized by staining with osmic acid but not with Sudan III, which shows them not to be simple fats or lipoids, but they are undoubtedy precursors of true fatty degeneration (Hess and Saxl[25]); they probably consist chiefly of lecithin (phosphatides) with more or less free fatty acids and relatively little cholesterol (Aschoff)."

Pighini and Barbieri have observed an increase of lipoid granules whenever the metabolism of the cell is slowed or in some way changed, as in senescence or with certain poisons or in certain diseases of the nervous system. To what extent we are justified in drawing conclusions from these observations on tissue degeneration has to be determined by a more thorough study of the different chemical constituents. It would seem, nevertheless, that the chemical picture obtained from our present studies of general paralysis is not unlike that of lipoid degeneration.

We should ask ourselves the question: Are these chemical changes observed in general paralysis typical of this disease or do they represent a general picture of nerve tissue degeneration? One might expect to find similar changes in a disease in which great or evidently acute destruction of nerve tissue has occurred. As far as we know, however, no other forms of mental disorder which have been studied chemically have shown such marked changes. Smith and Mair analyzed sections of degenerated areas of the brain in two cases of hemiplegia in which they found the cerebrosids decreased to an even greater extent than in general paralysis and the chloesterol more greatly increased. The phosphorus was also decreased. In dementia praecox, W. Koch found the brain practically normal except for the neutral sulphur fraction which in percentage of total sulphur was greatly diminished while the inorganic sulphur and protein sulphur were relatively increased. The nine cases examined by him, while varying among themselves, all tended in the same direction, namely, diminution of neutral sulphur. This variation appeared to be independent of the cause of death. Koch, therefore, concluded that it was not unreasonable to suppose that the subject of this mental disorder might possibly "possess a general bodily inherent deficiency for oxidation processes." In five cases of pellagra analyzed by myself a similar, although less marked, decrease of neutral sulphur was observed in the cerebrum with a tendency for this fraction to decrease in the spinal cord. Certain degenerative changes were also noticed in this disease although not as marked as in these general paralytic brains. No such marked change in the distribution of the sulphur was observed in general paralysis. On the other hand, the phosphorus and nitrogen fractions, which are more specifically identified with the structural elements of nerve tissue, have been changed, as indicated in the body of the paper.

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[24] Wells, H. G.: Chemical Pathology, Philadelphia, W. B. Saunders Company, Ed. 3, 1918, Chapter 14.

[25] Hess and Saxl: Virchows Arch. f. path. Anat. **202**:149, 1910.

SUMMARY

Extensive chemical analyses of five parts of the central nervous system in two cases of uncomplicated general paralysis show the following changes as compared with normal controls:

1. A tendency for the water and proteins to increase and for the lipoids as a whole to decrease.

2. The extractives (water-soluble substances) are considerably increased, and, since the total solids have been very little changed, these probably compensate for the loss of the lipoids, especially the phosphatids.

3. Of the lipoids, cholesterol shows a relative increase in all parts except in the cerebrum where it may be considered to be practically normal. The phosphatids (unsaturated lipoids of Fraenkel) show a consistent decrease presumably due to a disturbance in the lipolytic processes associated with the degeneration of the tissue. The cerebrosids and sulphatids (saturated lipoids of Fraenkel) show less consistent changes. Since these are largely associated with the myelinated sheath (white matter), which showed less change on the whole in these

brains than the gray matter, these have probably been less affected; the lipoid phosphorus and lipoid nitrogen were decreased, while the extractive phosphorus and extractive nitrogen were increased.

4. Other chemical studies of nerve tissue (whole brain) in general paralysis check these findings: Pighini and Barbieri (Fraenkel method) observed in twelve cases of general paralysis an increase of water and proteins and a decrease in the total lipoids. The unsaturated lipoids were greatly decreased and the saturated lipoids, while decreased as a group, varied among themselves. Cholesterol was increased. Smith and Mair found in three cases of general paralysis a decrease of lipoids (chloroform extract), and in fractionation of this chloroform extract, a marked decrease of the cerebrosids, the cholesterol normal and the phosphorus decreased. Nelson, who analyzed only one general paralytic brain, found the water and proteins increased and the lipoids as a whole decreased. The extractives are probably increased. The lipoid phosphorus and lipoid nitrogen were decreased while the phosphorus and nitrogen in the extractive fraction were increased.

5. These changes in general paralysis present a chemical picture of lipoid dgeneration, where the water and water-soluble substances have increased at the expense of the lipoids, especially the phosphatids.

6. From a comparative study of different forms of insanity we find that general paralysis differs from dementia praecox, for example, in that the destructive changes in the former affect several constituents and not one constituent in particular, while in dementia praecox, W. Koch found an unmistakable decrease in the nonprotein neutral sulphur fraction in both the gray and white matter of the brain though the other constituents appeared practically normal.

7. The cerebrum in these general paralytic cases shows perhaps the most consistent change in the different chemical groups, especially in the relative proportion of the lipoids to the extractives. The cortex shows a greater percentage variation from normal than the corpus callosum; the cerebellum and spinal cord show perhaps less changes than the cortex but more pronounced than the corpus callosum. Least of all affected was the corpus callosum.

8. Whereas the two cases of general paralysis show the same relative changes in the different parts of the central nervous system, Case 2 almost without exception shows more changes than Case 1.

9. Until recently very little systematic work has been done on the quantitative separation of the chemical constituents of nerve tissue. Practically no work appears in the literature on chemical changes in pathologic nerve tissue. We find only four references to the chemical examination of the brain in general paralysis. The methods used for the chemical study of the brain are very different so that only a broad comparison of findings in general paralysis could be made. The method

of Fraenkel and W. Koch compared favorably. When the chemical findings of each investigator were compared with normals determined by the same method, we could arrive at certain general conclusions concerning changes in general paralysis. These have been mentioned.

REPORT OF CASES

Case 1.—*Clinical Summary.*—George G., admitted Oct. 13, 1913, aged 38, a bookkeeper, who is said always to have been of a shy, retiring nature, but who had apparently been efficient at his work, from his own account had had syphilis at the age of 18. He was married at the age of 29; there were no miscarriages or children. After marriage his wife and he ran a small store, but it is said that the patient never waited on customers, leaving this to his wife. At about the age of 33 he became nervous and irritable, made blunders to which he was indifferent, and at the age of 35 he ceased working entirely, became filthy in his habits, and had numerous dizzy spells. He was supported by his wife. He complained a great deal, finally, of the noises in the street, and of people in the house where he lived, and went to the police asking for a warrant for a baby who was crying on the floor above.

On admission to the Manhattan State Hospital, he was unusually quiet and cooperated to the best of his ability in the examination, but at times became rather apprehensive, saying the attendants wanted to kill him. There were no hallucinations and there was no grandiose trend. He had spoken, however, of suing the landlord for $50,000 for not repairing a stove, and saw nothing unusual in this idea. He knew he was in a hospital, but could not locate it. It was said that he identified those about him correctly and that his memory for the recent past was "fairly good," but his mind was not clear concerning details. He gave a varying account of his life, but there were many discrepancies in dates, which he did not realize. There were only a few mistakes in calculation, in which he had probably been efficient as a bookkeeper. He believed that there was nothing wrong with his mind, and he had no plans for the future.

Examination.—On admission the pupils were unequal and irregular and reacted to light and accommodation; the knee jerks were exaggerated; speech was characteristic of general paralysis; lumbar puncture showed 40 cells and positive globulin; a Wassermann test was not made.

Course of Illness.—During the early part of his hospital residence he was up and around the ward, but he gradually became weaker and ataxic, and for at least ten months before death he was confined continually to bed. Mental deterioration was also evidently progressive, and he finally became markedly deteriorated; practically no information could be obtained from him. He gradually became exhausted and died Oct. 18, 1915.

Necropsy Examination.—This was performed twelve hours postmortem by Dr. Clarence O. Cheney. The remains were those of a tall, much emaciated, poorly built man of about 40 with sacral decubitus. The brain weighed 1,135 gm., was small, and showed a striking atrophy of the frontal lobes, the convolutions being about half their normal thickness; the widened fissures were filled with opalescent fluid. Less marked, but still evident, atrophy was present in the temporal, parietal and occipital regions. The cerebellum was of good size, without definite atrophy. Microscopic examination demonstrated in all sections characteristic changes of general paralysis, with extensive and marked thinning and disorganization of the cortex, in addition to the exudate in the pia, cortex and marrow of lymphoid and plasma cells. The neuroglia showed activity in the presence of large cell bodies containing pigment, and there was a good deal of pigment débris in the pia and along the cortical vessels. The vessels did not show syphilitic endarteritis, and there were no softenings.

The spinal cord was of good size, not appearing atrophic. The pia showed microscopically a moderate exudate of lymphoid and plasma cells, but this exudate was not evident in the substance of the cord. The anterior horn cells varied from normal to conditions of pigmentary degeneration, distortion and apparent atrophy, with a probable loss of cells in some places. No tract degenerations were evident.

Considering the previous bedridden condition of the patient, the appearance of the lungs was good, showing only a moderate purulent bronchitis and hypostatic congestion, without pneumonia. The aorta and other vessels were free from definite evidence of syphilitic involvement, and the other viscera showed no significant pathologic changes grossly or microscopically.

Case 2.—*Clinical Summary.*—Catherine E., admitted Dec. 16, 1913, aged 33, an Irish woman who was said to have been widowed but of whose early life nothing was known; admitted syphilis; at what age it was acquired is not known. No account was obtained of the onset of her trouble except that she had become confused and on April 7, 1913, was taken from the Salvation Army Home where she had been for two weeks.

Examination and Course.—She was admitted to Central Islip State Hospital on April 9, 1913, where she was still confused; she had a poor memory and made many contradictory statements. Her pupils were of the Argyll Robertson type. There were marked tremors; the knee jerks were absent; the Romberg sign was present, and the gait was unsteady. The Wassermann reaction in the spinal fluid was positive. After slight improvement she was discharged on July 25, 1913, to relatives in Pennsylvania. The diagnosis made was general paralysis.

The patient was admitted to the Manhattan State Hospital on Dec. 6, 1913, with no account of the interval. She was much disturbed and was very expansive, saying she was the Duchess of Denby, was going to marry King George, and had "loads of money." The physical signs were the same as at Central Islip. The spinal fluid showed a strongly positive globulin and 24 cells. The spinal fluid Wassermann test was not repeated.

During her residence she quieted down. She became bedridden as a result of ataxia, but she was good-natured, remained grandiose, and although she showed a poor memory for remote events, she was approximately oriented and her memory for events that happened in the ward was "quite fair." During her last year of residence she had two attacks of weakness. She recovered from the first after two weeks; the last began several days before death with gradual failure and a high temperature on the day before death. No physical signs were found to account for the temperature. She died, Jan. 27, 1916.

Necropsy Examination.—This was performed three hours postmortem by Dr. Clarence O. Cheney. The remains were those of a well built, muscular woman, appearing to be about 30 years of age; height, 5 feet 2 inches (157.5 cm.); weight estimated at 130 pounds (59 kg.), and emaciation was not noticeable. The brain weighed 1,015 gm., was small and showed marked atrophy, not only in the frontal regions, but also in the parietal and temporal regions. The atrophied tissue was sclerotic on palpation and on cutting. Microscopically there were the characteristic changes of general paralysis, with much meningeal and deep perivascular exudate of lymphoid and plasma cells, and thinning and disorganization of the cortex. The changes were most marked in the frontal sections, but diagnostic alterations were evident in all other areas examined, including the occipital regions. A few cerebral medium-sized vessels showed evidence of syphilitic endarteritis, but no obliterations were found and no gross or microscopic softenings were evident.

The spinal cord was small throughout, this being considered out of proportion to the woman's development. The pia was chronically thickened and opaque. Microscopic examination of cervical, thoracic and lumbar sections showed a characteristic meningeal and deep perivascular exudate. The anterior horn cells appeared well preserved except for moderate granulation in some of them. Myelin sheath stains showed a degeneration of part of the deeper posterior column fibers, but there was no clean-cut tract degeneration.

Except for a moderate purulent bronchitis and hypostatic pulmonary congestion, gross and microscopic examination of the thoracic and abdominal viscera showed no significant pathologic changes. It was considered that the cerebral process had been the cause of death.

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Abstracts from Current Literature

A CRITICAL REVIEW OF DECEREBRATE RIGIDITY. J. Lhermitte, Ann. de méd. **10**:228, 1921.

Some of our present ideas concerning certain rigid states brought about by injury to the nervous system are discussed fully. The fact that increased activity of functions controlled by the nervous system is due to the absence of a part of the nervous system and is not due to irritation, is given particular emphasis. The exceptions to this rule, as illustrated by jacksonian epilepsy, are also discussed. Lhermitte emphasizes the fact that the manifestations of transections of the dorsal portions of the spinal cord as well as of those injuries whose residua are manifested by spasticity and hemiplegia, are due to the liberation of inferior integrations rather than to irritation. These are negative rather than positive pictures.

Lhermitte, after an introduction giving credit to Hughlings Jackson, Head and Kinnier Wilson for the development of the conception of decerebrate rigidity, proceeds to analyze the experimental data which leads up to Wilson's idea of the occurrence of decerebrate rigidity in man. Sherrington removed all parts of the nervous system except the spinal cord, medulla, pons, midbrain and peduncles in monkeys and dogs. As a result the animals when suspended assumed a constant and peculiar posture. The four legs were carried backward and were adducted. The elbow was extended while the wrist was flexed and the palm of the hand in the monkey was turned outward. The hind legs were in marked extension and carried backward. The tail no longer responded to the effect of gravity but was maintained horizontally and sometimes curved upward. The dorsolumbar vertebral column, as well as the neck, was rigid and in a position of opisthotonos. This position resembled that of persons afflicted with tetany. The head was carried backward, extended, and the jaws tightly closed, due to contraction of the muscles of mastication. The rigidity was sufficiently marked to make passive movements difficult or impossible. An attempt to move the limbs increased the rigidity. During the first four days after the operation the muscles occasionally went into spasms. No tremor was present except shortly before death. Chloroform and ether anesthesia dissipated the rigidity. The injection of tetanus toxin or strychnin has been shown by Claude and Lhermitte to increase it. This picture is in marked contrast to that produced by section of the cervical or dorsal portion of the spinal cord, for when this was done the muscles were in a state of complete flaccidity. The well-known fact that the voluntary muscles of the body are bilaterally innervated lead to the supposition that hemisection would not produce the state of rigidity identical to that produced by total section. This hypothesis was proved true by Sherrington. The animal showed a homolateral rigidity which was not as constant as in the completely sectioned animals. Nor was the position exactly the same. The tail curved but also deviated homolaterally. The head was overextended but homolaterally directed. Lhermitte states that the homolateral forelimb was flexed. This is not Sherrington's or Wilson's statement. (Wilson, S. A. K.: *Brain* **43**:246.) The homolateral limbs were as in bilateral rigidity. The inconstancy of the rigidity suggested that the inhibitory activities of the intact half of the nervous system were in conflict with the released tonic centers of the operated half.

Lhermitte points out the importance of these experiments in formulating a conception of partial decerebrate rigidity. Having stated these experimental findings, Lhermitte describes the various interpretations which have been given them. He emphasizes the great importance of stimuli of a sensory character, either from special, general or visceral receptors. One method of cutting off the majority of these afferent stimuli is by section of the cord, and, as is well known, this, when attempted in hemidecerebrate rigidity destroys the rigidity and produces flaccidity. Supposedly section of the posterior roots destroys rigidity in the muscles segmentally related. To a certain extent this is true, but rigidity is not entirely absent. Furthermore, Brown has shown that stimulation of the midbrain in animals whose posterior roots had been cut would still produce rigidity in the muscles of the corresponding segments. Lhermitte observes that though the posterior nerves contain the majority of the afferent paths, some other pathway must exist. He mentions the work of Lehmann who showed that certain sensory fibers of visceral origin reach the spinal cord via anterior roots as a possible explanation.

The particular pathways within the spinal cord which carry sensations essential to the maintenance of rigidity and the experimental data showing that section of Gowers' tract in its entirety is not necessary to the maintenance of rigidity are then discussed. Cutting of the posterior columns and the track of Flechsig does not abolish rigidity. The work of Magnus and Kleijn showing that lateral movements of the head altered the position of the animal by stimuli passing through the vestibular apparatus and the cervical nerves, is mentioned.

Lhermitte leaves us without any clear notion of the exact afferent path concerned with rigidity as our present knowledge is not sufficient to define it. The center which controls tone is next considered. Lhermitte emphasizes again that this center lies somewhere between the upper portions of the midbrain and the caudal end of the medulla. He cites some of the evidence given to establish the part played by the cerebellum. However, this evidence, as he emphasizes, is by no means conclusive.

The nuclei of Deiters are next considered, and the work of Ewald which showed that the labyrinth exercised a tonic effect on voluntary muscles, is quoted. Sherrington and others have admitted that decerebrate rigidity and postural tonus are, in the major part, dependent on the integrity of the nuclei of Deiters. Thiele has shown that they are not the only factors. The red nucleus is next considered and the opinion expressed by Kinnier Wilson, as well as the evidence which this writer used, are offered to indicate that this nucleus plays a large part in the production of rigidity.

Lhermitte has omitted these observations of H. C. Bazett (*Brain* **43**:306 1920): "It is at any rate clear that decerebrate rigidity persists even after the rubrospinal tract is mostly degenerated, so that if the red nucleus is responsible for the rigidity it must be the lower part of this nucleus that is concerned; and it is established that the rigidity is not due to the excitation of nerve fibers divided in the operation, since in this case the rigidity could not be maintained after the degeneration of the fibers."

Summing up his information on the afferent and efferent paths concerned with tonus and posture found in decerebrate rigidity, Lhermitte states that the rigidity is due to the release of certain centers from the control of those parts of the nervous system lying above the cerebral peduncles. He calls our attention to the interesting observation of Sherrington that the rigidity affects with the greatest intensity those muscles which are least affected by cortical stimulation and whose contractions under normal conditions are concerned with the maintenance of posture. He emphasizes the importance of the extrapyramidal motor system to which he gives the name tegmentospinal. One of the important functions of this system is the maintenance of posture. Lhermitte fails to define the type of posture to which he alludes. It is quite obvious that any position of the body can be defined as a posture. The particular postural activity to which he refers, by the general use of the term, should be defined as antigravitational posture. Surely the position of the arm in posthemiplegic contracture is one of posture and cannot be identified with the position of the arm in decerebrate rigidity.

The tegmentospinal extrapyramidal system is inhibited on two sides, on one hand by the cerebral cortex and on the other hand by certain parts of the striate body. The pathway of inhibition by the first of these is via the frontopontocerebellar tract and the pyramidal tract. Stimulation of the frontopontile tract in the internal capsule always inhibits decerebrate rigidity.

To sum up the evidence given, it would appear that a tonic center exists in the brain stem, which is influenced by the more cephalad portions of the brain. The exact pathways to and from this center or group of centers have, as yet, not been determined with decision.

Kinnier Wilson, stimulated by the physiologic experiments of Sherrington, attempted to demonstrate a syndrome of decerebrate rigidity in man similar to that established for animals. Wilson found that not only did a condition exist in pattern identical to that found in animals, but that it could be caused by various pathologic states. The pathologicophysiologic characteristic is interruption, either anatomically or functionally, of the connections which unite the forebrain (diencephalon, telencephalon) with the inframesocephalic portions of the cerebrospinal axis.

From a clinical point of view, cases of decerebrate rigidity are divisible into two large groups. The first comprises those in which the state of decerebrate rigidity appears and consciousness is completely abolished. In the second group consciousness is not abolished. As might be expected, the cases falling into the first group resemble more closely experimental results than those of the second group. In view of this, Lhermitte begins his review by a discussion of decerebrate rigidity and tonic attacks combined with coma. Wilson reports five personal observations in which the decerebrate attitude was combined with tonic attacks similar to those described by Hughlings Jackson under the name "tetanoid attacks" (*Brain* **29**:425, 1906). These attacks, attributed to lesions of the cerebellum, differed from those of cortical origin in that they were not clonic but tonic. Jackson emphasized this contrast and pointed out in addition that in the cerebellar attacks those muscles whose action was synergistic were involved. The attitude during an attack, which was identical to that of decerebrate rigidity, was due to contracture of the muscles of the neck, of the dorsolumbar region and of the lower extremities. Both in decerebrate rigidity and in cerebellar attacks the attitude of the patient is that of tetanic opisthotonus. The head is pulled back, the dorsolumbar region curved forward, the lower extremities extended, the arms half flexed. The patient cannot talk or swallow, the latter being due to trismus which maintains the jaws tightly closed. That attacks of this kind are related to cerebellar lesions has been demonstrated by many anatomicoclinical observations, among which may be mentioned those of Jackson, Stewart and Holmes, MacEwen, Dana.

Russel, MacRobert and Laurent Feinier. Lhermitte then proceeds to give in some detail several case reports of Wilson.

In the second group of decerebrate rigidity without loss of consciousness, Lhermitte emphasizes the various postural fragments of the state of decerebrate rigidity which Wilson has illustrated in his article. Lhermitte notes that the posture of spastic hemiplegia represents a fragment of decerebrate rigidity. It is interesting to note here that in typical spastic hemiplegia the elbow is flexed, not extended, so that though one might speak of the position in posthemiplegic contracture as one due to a degree of decerebration, it is quite certain that one would not be justified in identifying that position described by Kinnier Wilson as decerebrate rigidity with the position of posthemiplegic contracture as Lhermitte has tried to do, nor would one be justified in identifying the position found in animals by Sherrington with the position of posthemiplegic contracture. At this point it seems worth emphasizing that the words decerebrate rigidity may come to be used rather loosely. It would seem much better to speak of the position of decerebrate rigidity described by Kinnier Wilson as the position of antigravitational posture, for, as was emphasized in the early portion of Lhermitte's review, the position in decerebrate rigidity is essentially that produced by the response to the need of counteracting the effects of gravity.

Lhermitte proceeds to give several case reports from Wilson's paper which illustrate fragments of the posture of decerebrate rigidity. The postural defects in unilateral cerebellar disease are introduced into the conception of decerebrate rigidity. The postural deficiencies of chorea and athetosis are included. The postural defects of dystonia lenticularis are also included. Lhermitte refers to the work of Pal, who showed the influence of changes in arterial tension on the occurrence of various types of fits. Sudden increase of tension produced fits like the tonic attacks of decerebrate rigidity. These could be reproduced by the injection of epinephrin.

Lhermitte attempts an analysis of the pathogenesis of rigidity. He emphasizes the fact that in the relatively few cases which have come to necropsy the ventricles were distended, the intraventricular pressure increased. Lhermitte explains the appearance of rigidity by a physiologic block analogous to the anatomic section of Sherrington, caused by pressure on the upper portions of the midbrain by increased intraventricular pressure.

To sum up: One is impressed with one thing throughout. Hypertonus and posture are brought too closely together. They must concern different parts of the nervous system however close to each other these parts may be anatomically. There is little attempt to emphasize the fact that hypertonus flows into different postural designs, as for example, those of posthemiplegic contracture, decerebrate rigidity and the "flexion-reflex" posture of spinal disease. The relation of the hypertonus to the involuntary nervous system is not emphasized. It is quite obvious that the involuntary nervous system is represented above the midbrain, that its primary neuron is cut by the lesion which causes the picture of decerebrate rigidity. Is the hypertonus a phenomenon of release due to this injury?

As has been noted in this review, the word "posture" or "attitude" is used too generally. Sherrington emphasized in several places the fact that in decerebrate rigidity the antigravity muscles are affected. Hence this posture should be designated as antigravitational posture.

Kraus, New York.

SOME PECULIARITIES IN THE DEVELOPMENT AND IN THE MYELINIZATION OF THE SPINAL CORD. E. D'ABUNDO, Riv. ital. di neuropatol. psychiat. ed elettroter. **14**:65-93 (March) 1921.

The author has studied the development and the myelinization of the different sections of the spinal cord in human fetuses at various periods of growth (as old as six and seven months), in infants 5, 8, 44, 75 days, 3, 11, 14, 24, 36 months old, and in embryos of animals (*Mustelus levis, Torpedo occellata,* chicks and rabbits). He followed the development of the ependymal and the nuclear zones (gray matter), and of the marginal substance (white matter) of the spinal cord; the formation of myelin in the nervous fibers, constituting the different bundles and tracts, and the anterior and posterior roots; the myelinization of the anterior and posterior horn cells. Special attention was paid to the study of the cervical and lumbar enlargements. Two acephalic fetuses were also studied.

Fifty-two illustrations are included in the text. The article may be summarized thus: The differentiation of the gray spinal substance is more rapid in the anterior horn, and it manifests itself with a diminution of the condensation of the embryonal cellular elements; this condensation becomes more intense toward the posterior horn where it reaches its greatest density in the more peripheral zones.

In human fetuses a coordinate relation exists between the evolution of the ependymal zone and that of the nuclear zone. With the differentiation of the latter coincides a thinning of the corresponding ependymal zone which follows the same phases of differentiation of the nuclear zone, namely, it is maximal anteriorly and minimal posteriorly. This observation tends to confirm the fact that the anterior horn precedes the posterior horn in the histologic evolution. The most probable explanation of the phenomenon is to be found in the later dorsal closure of the medullary tube; the embryologic cause seems to account for the later differentiation of the posterior spinal portion in the first period of fetal life.

To the precocity and rapidity of development of the cervical enlargement (a fact which the author partially attributes to the precocity of the voluntary movements of the upper extremities) does not correspond a precocious myelinization of the intercellular fibers of the gray substance in the cervical enlargement, if compared with the lumbar enlargement; on the contrary, in the lumbar enlargement a more marked condensation of the medullated intercellular fibers, some of which are unusually large, is early visible. At the seventh month of prenatal life the myelination of the lumbar cord is by no means behind that of the cervical enlargement. This fact may be related to the medullary automatism of the deambulation having its center in the lumbar enlargement.

The myelination of the gray substance is decidedly developed at the sixth month of fetal life; however, the intercellular fibers are more markedly and more rapidly myelinated in the anterior portion. This condition is not due alone to the slower differentiation of the posterior horn but to the fact that the territory of the substantia gelatinosa of Rolando, although the richest in finer neurons, is poorer in medullated fibers, and its neurons possess delicate axis cylinders which are almost lacking in collaterals during their vertical transit through the spinal columns; besides, it is after birth that the fibers of the zona radicularis postero-lateralis of Flechsig, which go to the stratum spongiosum substantiae Rolandi dorsalis, are myelinized.

The anterior spinal commissure myelinizes early in fetal life and reaches its almost complete development during the first months of postnatal life. Through this commissure pass only a very small portion of the fibers constituting the column of Türck; the remainder of the fibers most probably run in a direct tract. The posterior commissure also undergoes an early myelination; however, this is slower in reaching its maximal development in postnatal life.

Already at birth there exists a maturity of the myelinization of the spinal cord sufficient to the immediate requirements of the life of nutrition and of the life of relation. This maturity takes place independently from the cerebrum, as demonstrated by the study of the acephalic fetuses.

The persistence of some fetal characteristics of the human lumbar cord even in the adult might explain the great predisposition of this section of the cord for the morbid localization of some neuropathies (acute poliomyelitis, myelitis, etc.). This fact tends to specify what may essentially signify the constitutional predisposition to diseases of determined portions of the spinal cord, in the presence of exogenous and endogenous morbid causes, especially when in the normal course of the embryonal development the posterior part of the medullary tube is subject to alterations and arrests of development.

Naccarati, New York.

THE WASSERMANN REACTION IN CASES OF TUMORS OF THE CENTRAL NERVOUS SYSTEM. F. Lotmar, Schweiz. med. Wchnschr. **51**:1013 (Nov. 3) 1921.

In 1910, Oppenheim and others reported cases of brain tumors with positive blood Wassermann reactions in which subsequent investigations and postmortem findings revealed no evidence of a syphilitic process. Since then several cases have been reported with similar findings. Nonne believes that only a positive Wassermann reaction of the spinal fluid is indicative of a syphilitic process in the central nervous system and that a positive blood Wassermann reaction alone has no significance. Other workers, however, disagree with Nonne's views as cases of meningitis, brain tumor and spinal cord compressions are on record in which a positive spinal fluid Wassermann reaction on later investigation proved to be nonspecific.

Lotmar reports a case of cerebellopontile angle tumor which at postmortem showed a xanthofibrosarcoma with no evidence of central nervous system syphilis. A spinal puncture in June, 1920, showed a strong positive Wassermann reaction in several dilutions with a positive Nonne reaction and six cells. Specific treatment was of no avail. A second spinal fluid examination in August revealed a negative Wassermann and a positive Nonne reaction. The postmortem findings revealed a tumor.

The author takes up the various possibilities which might account for the specific Wassermann reaction. He is inclined to look on the finding as a reaction frequently seen in certain diseases in which there is a central nervous system involvement, as in scarlet fever, pellagra and poliomyelitis. Positive Wassermann reactions of both the blood and spinal fluid have been found in other diseases, such as epidemic encephalitis, leprosy and tuberculosis. In the author's case the possibility of a coincident syphilis seemed to have been ruled out. Cases of tuberculous meningitis with a negative blood Wassermann reaction but a positive reaction in the spinal fluid have also been reported, and at postmortem examination syphilis could not be demonstrated. Of late positive Wassermann reactions have also been reported in cases of epidemic encephalitis.

Regarding tumors of the central nervous system, several authors have reported cases with a positive Wassermann reaction in the spinal fluid. Müller reported such a finding in a case of cerebral glioma. A positive reaction has also occurred in extramedullary tumors of the cord, in compression myelitis due to tuberculosis and in neurofibromatosis. Since 1915, Nonne has seen two cases of tumor cerebri with positive blood and spinal fluid Wassermann reactions in which histologic examination showed no evidence of syphilis. Oppenheim reports a similar finding. Nonne says that this unusual reaction has not yet been explained. Stern reported a case somewhat similar to that of the author's in which the specific reaction was attributed to a tertiary malaria which the patient had had shortly prior to the onset of the tumor symptoms; this the author believes was an incorrect assumption.

The author believes that it may be possible for a positive Wassermann reaction in the blood to follow a central nervous system neoplasm. A positive blood Wassermann reaction is frequently seen in sarcomas and carcinomas occurring outside of the nervous system; the cases of Lotmar and Sterns might be considered in this group as they were both sarcomas.

In offering a possible explanation for this positive spinal fluid finding the author believes it possible that the tumor may cause lipoid changes which produce the specific reaction. Similar reactions have been obtained by Wassermann who obtained positive reactions in the spinal fluid by the injection of lipoids. Similar experiments have been performed by others. In his conclusion the author summarizes the findings in his case of xanthofibrosarcoma; he believes that in his case the nonspecific reaction was due to the tumor itself, probably to the formation of lipoids.

Moersch, Rochester, Minn.

TWO CASES OF CEREBROSPINAL CYSTICERCUS. L. Redalié, Rev. neurol. **28**:241 (March) 1921.

Redalié directs attention to the difficulty presented by this condition from the standpoint of both clinical and histopathologic diagnosis. His protocols may be summarized thus:

The first case was that of a woman, aged 54, with a history of headaches and pain along the spine, dating back ten months. There was also equilibratory disturbance unattended, however, by loss of consciousness or vertigo. This condition persisted essentially unchanged until several weeks before death, when there were noted urinary retention, constipation with incontinence, marked general motor paresis, associated with fixation and dilatation of the left pupil, ptosis of the left eyelid and diplopia. In the sensorial field, there was determined definite diminution in general sensitivity almost to the degree of anesthesia. The deep reflexes were definitely exaggerated, with marked ankle clonus, and the Babinski and Kernig signs were strongly positive. Mentally the patient showed definite deterioration in all fields, particularly in the mnemonic. The spinal fluid showed a positive Wassermann reaction with marked lymphocytosis and albuminosis. Postmortem examination revealed a racemous cysticercus, involving the meninges on the ventral aspect of the brain, essentially in the intrapeduncular space, extending forward to the tips of the temporal lobes and posteriorly almost to the pons, with marked evidence of chronic meningitic involvement throughout this region, internal hydrocephalus and indication of obliterating endarteritis, implicating practically the entire basal vasculature. The cervical cord showed another cysticercus, of the racemous type, involving the meninges ventrally and associated with marked chronic hypertrophic pachymeningitis. Degenerative changes were found in the spinal nerves of this region with atrophy of the anterior horns and softening in the posterior columns.

The second case was that of a man, aged 66, who had suffered epileptiform attacks for fifteen or sixteen years and who, for a year preceding his death, complained of difficulty in walking. There was later noted definite feebleness in the lower extremities and severe headaches. When seen by the author, some months prior to death, the patient showed marked mental deterioration, particularly in the mnemonic field. The pupillary reactions were sluggish, and there were also noted slight right hemiparesis, marked tremor of the extended fingers and tongue, with rigidity of the lower extremities and inability to walk. The blood Wassermann reaction was negative, and the spinal fluid Wassermann reaction was at first positive, but following a course of arsphenamin became negative, although there was persistent indication of pleocytosis. Postmortem examination showed very well marked cerebrospinal cysticercosis with a parasitic cyst of the floating type in the fourth ventricle. The base of the brain showed marked chronic meningitis with obliterating endarteritis of the basilar and sylvian vessels. The entire brain was somewhat atrophied with indication of internal hydrocephalus and granular ependymitis.

In commenting on these cases, the author remarks on the occurrence of the cardinal features usually described with cerebrospinal cysticercus—headaches, pupillary disturbance and paretic changes with epileptiform attacks and general psychic deterioration. The long duration in the second case possesses a certain interest as well as the fact that both of these cases seem to have been associated with syphilis, a feature rendering especially difficult the matter of exact diagnosis on a histopathologic basis. The author includes an excellent discussion of the literature, particularly from the semiologic standpoint.

Raphael, Ann Arbor, Mich.

FRACTURES OF THE SKULL: DIAGNOSTIC AND PROGNOSTIC FEATURES. J. W. Stewart, J. A. M. A. **77**:2030 (Dec. 24) 1921.

The author reviewed the records at the St. Louis City Hospital over a period of five years and found 6,135 cases of cranial injury. Of these 617, about 10 per cent., showed definite signs and symptoms of skull fracture. The average age was 36 years, and the sex ratio was 65 males to 35 females. Of the 617 skull fractures, 209 were basal; 408 were fractures of the vault, 198 depressed and 210 linear.

Roentgen-ray examination was positive in 73.1 per cent. and negative in 26.8 per cent. Three hundred and three patients, 49.1 per cent., were unconscious on admission to the hospital; 193, 33.2 per cent., were conscious, and 121, 19.5 per cent., semiconscious.

The author reviews the various immediate symptoms, such as vomiting, lowered pulse rate, and bloody or clear spinal fluid. Various neurologic examinations were conducted. The average pulse rate was 92 in patients who did not vomit and 83 in patients who vomited; this emphasized the point that the pulse rate was higher than is usually expected to exist in skull fracture cases. In 165 of the 617 patients a spinal puncture was performed and the cerebrospinal fluid found to be bloody in 90.5 per cent. Six of the fifteen patients with a clear spinal fluid proved to have linear fractures.

In a total of 209 cases of basal fracture, the pupils were equal and reaction normal in ninety-two cases, unequal and reaction normal in ninety-four cases, and equal, dilated and fixed in twenty-three. The various neurologic findings depended on the extent and degree of the injury.

In summarizing the final results of skull fractures, the author submits the accompanying table, but calls attention to the fact that operation was not performed in some of the more severe cases:

Results in Six Hundred and Seventeen Cases

	Number of	Died		Recovered	
Cases	Cases	Number	Per Cent.	Number	Per Cent.
Nonoperative	443	232	52.37	211	47.63
Operative	174	90	51.7	84	48.3
Total	617	322	52.19	295	47.81

Adson, Rochester, Minn.

ANISOCORIA DEPENDENT ON SYMPATHETIC REENFORCEMENT.

C. Lafon, Rev. neurol. **28**:274 (March) 1921.

The author calls attention to the fact that anisocoria per se need by no means be considered as preeminently syphilitic in basis or even necessarily of encephalic locus. He refers at length to the work of Roque and Sergent, indicating the importance of intra-abdominal and intrathoracic pathologic changes in the production of such changes, particularly the homonomous mydriases. The mechanism of causation in such cases, the author feels to be essentially excitation of a reenforcing or overflow character effective on the ipsolateral sympathetic pupillomotor fibers, produced in the passage cortically, through the medulla, of centripetal stimuli originally impinging on the sympathetic elements in the cord, from the intra-abdominal or intrathoracic points of specific lesion.

This disturbance appears to be essentially of a dissociating type, that is, it is characterized by mydriasis only and not by the complete sympathetic syndrome mydriasis, widened palpebral fissures, exophthalmos and hemifacial vasomotor constriction, thus indicative of effect on the pupillomotor fibers alone before they have become definitely organized in tract form with the other fibers of the series. This reenforcement stimulus augments the normal tonus of the pupillary mechanism but naturally on the side of dilatation and as the pupillary elements of the third nerve are not affected, the pupillary inequality produced is most manifest in faint light with no implication of the accommodation or light reflexes. This reaction, which may also occur in connection with dental or intranasal pathology and disorders of the external auditory meatus, Lafon terms the Roque sign. By the same token, in connection with irritant foci of an essentially intracranial nature, reenforcing effects may make themselves manifest on the parasympathetic elements of the pupillary complex with resultant homonomous myosis, also most prominent in dim light and unattended by change in the responses to light and accommodation.

In contrast to anisocoria due to actual intracranial involvement of the pupillary centers as such, where the light reflex is still present, this mydriasis and myosis, due to sympathetic or parasympathetic reenforcement, are most marked, as indicated, under conditions of feeble illumination and tend to disappear under strong light, whereas the former is most noticeable under strong illumination and tends to become progressively less manifest with diminution in illumination intensity.

Raphael, Ann Arbor, Mich.

PSYCHIATRY AND NEUROLOGY IN THE REVISED MEDICAL CURRICULUM. K. Bonhoeffer, Monatschr. f. Psychiat u. Neurol. **48:** 327 (Dec.) 1920.

". . . But it is not sufficient that the student learn in a general way what are the criteria of organic and functional nervous diseases; and what he is to do when he meets with a mental case. Many of the older practitioners feel that the duty of a psychiatric clinic is exhausted when it makes a diagnosis of a mental disease and determines the question of commitment. But the psychiatric and nervous clinic has a wider, and perhaps more important, duty. It must make the student appreciate the significance of the psychic not only in psychopathology, but in the whole field of medical practice. A little of this he may get in his general clinics. But the essential tendency of the general clinic is toward the material—the objectively demonstrable; and we realize from a survey of average medical practice that psychic and psychically induced symptoms are not fully appreciated. Were the psychic better understood, we would not have the eternal search for local findings to explain every symptom. The physician forgets that there are innumerable anatomical anomalies which are a matter of utter indifference to the psychically normal individual; anomalies which never produce a symptom and never cause him to consult a physician. How many times do uterine displacement, floating kidneys, gallstones, enteroptoses, septum deflections, swollen turbinates and enlarged tonsils gain significance simply because the physician in his search for the objective unnecessarily directs the attention of his psychoneurotic patient to them. How many unnecessary operations are performed simply because of misinterpretation of subjective complaints, to say nothing of how much compensation is unnecessarily paid because the physician assumes an organic trouble when as a matter of fact the subjective complaints are psychic in origin—dependent on a desire for compensation. And it is not only a failure to recognize the hysterics—this mistake is not as common as the failure to recognize depressive attacks, the manic depressive constitution and other psychopathies, masquerading under the guise of local diseases. Much of the success of the quacks is due to the fact that physicians undervalue or wholly fail to recognize the psychic element in disease causation. There is no doubt but that this phase of psychopathology is an important part of the general training of the physician."

Selling, Portland, Ore.

A TENDON TRANSPLANT FOR INTRINSIC HAND MUSCLE PARALYSIS. K. Winfield Ney, Surg., Gynec. & Obst. **33**:342, 1921.

The author says that the results observed following suture of the peripheral nerves have surpassed all expectations. The apparently slow rate of regeneration through the distal segment of a sutured nerve is, however, often discouraging to the patient. It may be necessary to wait many months before an objective sign of a successful suture appears, that is, the return of voluntary power in the formerly paralyzed muscles.

The return of voluntary power is first observed in the larger muscles, and, although very slight at first, it gradually increases. The smaller and more distally located muscles, such as the intrinsic muscles of the hand and foot, are the last to manifest return of voluntary motor power. This is due to their distal location and the great amount of time required for the regenerating motor neuraxons to reach the end plates in the muscle fibers. Another factor of great importance is the muscular volume of these intrinsic muscles; this is so small that during the long period of paralysis, before the regenerating neuraxons can reach them, they have undergone marked atrophy and retain little of their former muscular tissue.

In combined median and ulnar nerve paralysis regeneration of the extrinsic muscles is more or less complete in from twelve to eighteen months following successful nerve suture. In a series of forty-two cases of combined median and ulnar paralysis with successful restoration of most of the extrinsic muscles only three showed, on last observation, any evidence of returning voluntary motor function in the intrinsic muscles of the hand supplied by these nerves.

The author had extensive experience in peripheral nerve surgery during the war in General Hospitals No. 3 and No. 41 of the United States Army and is convinced that some of the intrinsic muscles of the hand fail to function, even though there is partial regeneration in the larger muscles. One of the most serious of these failures is lack of regeneration in the thumb. In order that the thumb can be extended as well as flexed and the hand made more useful, he has devised a plastic operation on its tendons.

In résumé, the author calls attention to the important fact that the neurologic surgeon interested in nerve anastomosis should not forget the possibilities offered by tendon transplants when regeneration fails.

Adson, Rochester, Minn.

CLINICAL AND ANATOMIC CONTRIBUTION TO THE KNOWLEDGE OF THE LENTICULAR NUCLEUS (A CASE OF WILSON'S DISEASE). G. Borsari and G. Bianchi, Quad. di Psichiat. **8**:9-10 (Sept.-Oct.) 1921.

A girl, 13 years of age, intra vitam showed hypertonus, contractures, especially in the muscles of the extremities, and disturbances of deglutition and speech disorders, which began as dysarthria and which reached the degree of anarthria. Although the disease was in an advanced stage, there were no tremors, no convulsions and no psychic alterations. Necropsy revealed bilateral degeneration of the lenticular nucleus without a lesion in the internal capsule, cirrhosis of the liver with large nodes and a large splenic tumor. There was microgyria in the frontal lobes, especially on the left. No syphilitic changes could be demonstrated.

The authors conclude that this case, in which there were deep lesions without involvement of the internal capsule, clearly confirms the relationship of the lenticular nucleus to the motor functions, and demonstrates the possibility that deep destructive lesions of the lenticular nucleus may exist with complete integrity of the sensory functions. They see in this case a proof against the conception of Déjerine who believed in the involvement of the internal capsule in Wilson's disease.

After discussing the symptomatology of the lenticular nucleus the authors conclude that a correlation must exist between the lesion of this nucleus and pseudosclerosis of Westphal-Strumpell, Huntington's chorea, dystonia musculorum deformans of Oppenheim, Parkinson's disease, spasmodic pseudobulbar paralysis with contractures and choreic-athetosic movements of Oppenheim and Vogt, progressive athetosis and apoplectic amyotonia of Bechterew.

Naccarati, New York.

THE NATURE OF CHOREIFORM MOVEMENTS—CAN THEY BE INTERPRETED AS REFLEXES? André-Thomas, Presse méd. **30:** 25 (Jan. 11) 1922.

Two cases in which the patient exhibited choreiform movements are discussed, with numerous illustrations. One showed pyramidal and cerebellar signs, and synkinesis was marked. Synkineses appeared not only with the upper and lower extremities, but also with movements of the head, tongue and eyes. The movements which were produced on the left side when the right extremities or the head were moved gave the impression of reflex rather than of associated movements. This impression was even more definite when one used other means of stimulation, such as pricking or tickling. For any given point of stimulation, provided the stimulus was sufficiently strong and prolonged, the reaction appeared promptly and in a constant direction. The response was livelier in proportion to the degree of stimulus. Pressure on a given area excited a response, but if the pressure was maintained with the same intensity, the response ceased. The phenomena of decerebrate rigidity are compared.

Movements in the second case were those of typical Sydenham's chorea, but they did not appear spontaneously, and synkineses were exceptional. The movements were induced, not by peripheral stimulation as in the first case, but exclusively by conversation and by a certain degree of psychic activity. In both cases the choreiform movements were excited in an apparently reflex manner. Such "reflexes" are doubtless different from those ordinarily included under that name, and yet the reflexes already known are not all necessarily referable to the same mechanism. The list of reflexes might be enlarged and revised.

Huddleson, New York.

TECHNIC OF NERVE SURGERY. K. Winfield Ney, Ann. Surg. **73:** 37, 1921.

The author submits a very straightforward article emphasizing the important steps in nerve repair based on an experience of 300 peripheral nerve operations and personal supervision of 1,500 such cases.

Ney advises local anesthesia, with 1 per cent. procain solution containing 15 drops of epinephrin chlorid (1:1,000) to each 30 c.c. of solution. The "non-touch," or purely instrumental, nerve suture is advocated with great stress on the accurate approximation of severed ends and the avoidance of torsion. Moderate primary stretching of flexion relaxation, transposition, two stage operations when necessary, and only occasional use of autogenous cable grafts may be used in overcoming nerve gaps.

The author has used several homografts, refrigerator stock, with unsatisfactory results; in a few patients the autograft has proved partially successful. He lays stress on the preparation of the nerve bed, freeing it from scar tissue, and transferring the nerve into planes of normal tissue. He discourages the use of fascia lata, veins, Cargyle membrane, tubes, and so forth, and emphasizes the importance of avoiding injury to the nerve itself. Suturing is accomplished by fine silk epineural sutures, approximately eight in number. Neurolysis should be employed more frequently and even in cases of ischemic paralysis, dividing the epineurium and perineurium, and isolating the funiculi.

Adson. Rochester, Minn.

ON THE GROWTH OF THE LARGEST NERVE CELLS IN THE SUPERIOR CERVICAL SYMPATHETIC GANGLION OF THE ALBINO RAT FROM BIRTH TO MATURITY. Chi Ping, J. Comp. Neurol. **33**:281-311 (Aug. 15) 1921.

ON THE GROWTH OF THE LARGEST NERVE CELLS IN THE SUPERIOR CERVICAL SYMPATHETIC GANGLION OF THE NORWAY RAT. Chi Ping, ibid., pp. 313-338.

These two papers contain the report of a study of the changes in size and morphologic characters of the largest cells of the superior cervical ganglion in the post natal development of three groups of rats: standard albinos, inbred albinos, and wild Norway. In standard albinos between birth and maturity the diameter of these cells increases about 55 per cent., and the increase in the nuclei is less than half this amount. The nucleus-plasma ratio increases from 1:4 at birth to 1:12 at maturity. In adult inbred albinos the nuclei are the same size as in the standard strain, but the diameter of the cells is less. The nucleus-plasma ratios in the inbred albinos are about half as great as in the corresponding cells of standard albinos. In the wild Norway rat the nucleus-plasma ratio increases from 1:5 at birth to 1:12 at maturity. The diameters of nuclei are the same as in standard albinos, but those of the cell bodies are slightly less.

C. J. Herrick, Chicago.

VISUAL DISORDERS AFTER LOSS OF BLOOD. A. Terson, Presse méd. **29**:974 (Dec. 7) 1921.

Single or repeated losses of blood occasionally bring on various visual disorders, which may be accompanied by definite blindness with optic atrophy, this last complication being relatively rare. Ordinarily the visual trouble appears between three and eight days after the loss of blood—never before the third day nor after the third week. It may take the form of (1) hemeralopia, quickly recovering; (2) homonymous hemianopsia of cortical origin, without eyeground changes and with fixed scotomas; or (3) diminution in acuity of vision, bilateral or unilateral, progressing rapidly toward partial or complete blindness, and ordinarily incurable.

These disorders occur most frequently after 40, and in women. Hemorrhage from any cause may be the cause. The optic lesion is most often peripheral; other cranial nerve or polyneuritic disturbances may occur at the same time. The mechanism is obscure; the author does not believe that ischemia alone or arterial hypotension is responsible, but he is inclined to believe that anaphylactic phenomena are involved. Possibly products of degeneration are absorbed from the wound, causing a special neurotropic toxemia. Necropsies have shown an ascending atrophy of the optic nerve, beginning peripherally with retinal lesions and without signs of infection, inflammation, embolism or thrombosis. (It is of interest to compare with this article a recent American Report on "Optic Neuritis in Serum Sickness" by V. R. Mason, *J. A. M. A.* **78**:88 [Jan. 14] 1922.)

Treatment is to be directed against ischemia and toward moderate congestion. Stimulants, transfusion and certain local operative measures are also suggested.

Huddleson, New York.

Society Transactions

BOSTON SOCIETY OF PSYCHIATRY AND NEUROLOGY

Regular Monthly Meeting, Dec. 15, 1921

James B. Ayer, M.D., *President, in the Chair*

INFLUENCE OF VISION ON NYSTAGMUS. Dr. C. L. Woolsey.

Isaac Jones has said, "The intimate relation between the ear and the eye can be best appreciated when we realize that the ocular mechanism depends upon stimuli from the ear for precision of movement." The intimacy of this relation may be greater than anticipated, if we note the inhibitory influence of vision over the outward manifestations of vestibular function.

There has been a great deal of discussion since the time of Flourens (1828) in regard to the cause of the "compensatory movements" or "with nystagmus" during rotation. When a normal pigeon is rotated, head free, certain movements of the head are noted, that is, the head seems to move slowly away from the direction of rotation, then quickly in the direction of rotation. These movements are called the "with nystagmus." Gruenberg (1907) thinks the compensatory movements may be due to the constantly changing view, but further states, "They may also be quite independent of visual impressions. One is therefore driven back to a reexamination of the semicircular canal theory, or to search for some other percursory movements or acceleration." Together with Prof. Wills he concludes that the "compensatory movements" are due to the spin which objects are subject to, when rotated. Isaac Jones (1918) states, "During the turning there is a vestibular pull of the eyes to the left, that is to say, a nystagmus toward the right"—when rotating to the right. Rizto, London (1920), concurs in this belief, briefly summed up, "The semicircular canals produce the compensatory eye movements when the head is in motion." In performing a number of experiments on the vestibular apparatus of the pigeon, it was evident that the "with nystagmus" of head or eyes during rotation depended in frequency on the rate of rotation, ranging from one to twelve movements of the head through 360 degrees. It was noted that the eyes did not enter into the movements per se, if the head was free to move, but if the head was stationary the eyes moved. It seemed probable that vision was partly responsible for these movements on account of the range from one to twelve. Vestibular stimuli could hardly produce such a variation, consequently numerous methods were employed to overcome vision without destroying sight, but all proved unsatisfactory. Following a suggestion of Dr. Stanley Cobb, experimental amblyopia was attempted. This was best secured by injection of a saturated solution of ammonium sulphate into the retina, which produced amblyopia without destruction of the iris, allowing subsequent interpretation of nystagmus with ease. Jones states that it requires approximately ten rotations of a human being to cause the "after nystagmus." Ten rotations of the normal pigeon in ten seconds produced an "after nystagmus" lasting for 3.2 to 4.6 seconds. When a pigeon with experimental amblyopia was rotated head free one revolution in ten to twenty seconds there was no compensatory movement or "with nystagmus" of either eyes or head, which seems to refute the idea that the "with nystagmus" was due to "vestibular stimuli." The contention may be raised that the rate of rotation was too slow to produce any movement of the endolymph, but this is erroneous since the same pigeon with amblyopia, when rotated one revolution in 20 seconds, developed no "with nystagmus," but an "after nystagmus" lasting for from 5 to 6.1 seconds. When rotated one-half turn in 10 seconds there was no "with nystagmus" but an "after nystagmus" lasting for 3.1 seconds. When rotated one-quarter turn no "with nystagmus" developed, but an "after nystagmus" of 2 seconds' duration. When rotated ten times in 10 seconds there was a "with nystagmus" and an "after nystagmus" lasting for 12 seconds. The "with nystagmus" was due to the head being pivoted and not able to keep up with the body, hence a twisting of the head away from the direction of rotation. This "twist" disrupts the muscle balance, which is the stimuli that causes the correction and thereby produces the "with nystagmus."

In conclusion: In the normal pigeon it requires at least five revolutions to produce any appreciable "after nystagmus," which is always accompanied by a "with nystagmus." With experimental amblyopia only one quarter of a turn in five seconds is required to produce an "after nystagmus" of two seconds' duration, which is not preceded by a "with nystagmus," which when compared with the normal pigeon shows the profound influence of vision on nystagmus. (A Preliminary Report of Experiments Being Done on Vestibular Apparatus of the Pigeon in the Neuropathological Department of the Harvard Medical School.)

PROGRESSIVE MUSCULAR DYSTROPHY IN A MOTHER AND THREE CHILDREN. Dr. H. B. Eaton.

Looking through the literature on this type of disorder I find that we are in about the same position regarding it as we were in 1886. The family shown is a particularly good illustration of the disease. The mother says that she first noticed her difficulty when she was 15 or 16 years old by a weakness of the arm which she attributed to falling out of a swing. The two oldest children, 13 and 12, have noticed for four or five years that they were unable to do what their friends did. The second boy, for instance, could not play basketball. The little girl of 6 has no trace of the disease so far as I am able to find. In the woman the reflexes are absent. In the older boy there are no tendon reflexes, but in the other boy they are diminished but present. The boys react to faradism but the mother does not.

DISCUSSION

Dr. F. J. Farnell: I have had under observation for the last seven years a Jewish family of three boys and two girls, with dystrophy. The oldest boy, 16 years old, has fully developed pseudomuscular hypertrophy with an inability to move about. The second is a boy of 13 who has a full fledged case and has to be carried to school. In the third child, a boy of 11, the disorder is fully developed. The fourth and fifth children, girls of 8 and 6 years, are quite well. There is no evidence of this disorder in either side of the family. A rather interesting feature is the effect of sugar on these cases. By feeding them a great deal of sugar and raising their tolerance they become more active, and the two boys who are able to get about seem to last longer at their play. The sugar content in the blood on a starvation diet is usually 90 mg. per 100 c.c. of blood which is somewhat low. The tolerance stays up on the sugar diet. Whether this has any significance in the interpretation of the disorder I really do not know. When the first boy came under my care about eight years ago I began to give him very large doses of pineal gland and for a while he seemed to improve and hold his own. The only additional experience I have had with endocrine glandular substance in relation to pseudomuscular hypertrophy was a marked case of pseudohypertrophy in which the patient for five years has been under large doses of pineal gland, and the disorder today is no further advanced than it was five years ago. In this case also the blood chemistry in relation to the sugar metabolism showed a similar picture. The method which has been used in feeding for sugar tolerance is to give an ounce of honey, preceding the induction by a blood sugar test, and then in one hour to make another examination for blood sugar; a third examination is made two hours after the honey is taken. In these cases the sugar content of the blood will remain up longer than normal. In a normal person the tolerance will rise within the first hour and it will drop to approximately normal by the end of the second hour, which, as I understand, indicates a normal sugar retention. Should the sugar content in the blood remain up at the end of the second hour it is called a high sugar tolerance.

Dr. D. J. MacPherson: We have one boy of 12 with this condition which started when he was about 7 years old. He has an infantile sella. I gave him pituitary substance and could see no difference except the effect it had on his headache which he had on an average of once every ten days or two weeks. In about six months he reported that he had had no headache during that entire time. Aside from that, there was no particular change in his condition. I used the whole pituitary.

THE USE OF SODIUM CHLORID IN CONCUSSION OF THE BRAIN.

Presentation of Cases. Dr. Hugo Mella.

Many patients who have received blows on the head develop headache of an extremely persistent type—often this headache does not commence until anywhere from several hours to a week or two after the injury. These headaches are not relieved by the ordinary remedies nor can they always be considered as the result of malingering to aid the patient in obtaining compensation, as they often occur in those cases in which this problem is not involved.

Venous congestion in the fundus of the eye or even choked disk may be found, but ordinarily nothing abnormal is elicited on physical examination; all that we find is a history of headache coming on after the cranial injury. It being a well-known fact that severe concussion of the brain may cause an edema of such a degree as to require decompression operations to save vision, if not life, I have thought for some time that those patients who have only headache might very well have an edema of the brain of a moderate degree and that if this fluid could be removed from the brain and the cerebral blood vessels be relieved of this pressure so as to reestablish a normal circulation, the headache would disappear.

In 1919, Weed of Baltimore reported in the *American Journal of Physiology,* that the injection of a 30 per cent. solution of sodium chlorid or a saturated solution of sodium bicarbonate into the circulatory system would reduce not only the cerebrospinal fluid pressure but also brain bulk. This reduction of cerebrospinal fluid pressure and brain bulk also results from the introduction of a hypertonic solution into the intestinal tract. It would not be practical to use the intravenous method in ambulatory cases, so, when the patients can tolerate it, I have them drink the salt in solution, as I believe that if a hypertonic solution will reduce brain bulk experimentally in the lower animals it might relieve these cases of "mild" edema of the brain. Should the patient be nauseated by the salt solution, I have the salt put up in capsules of 0.5 gm. each. Weed has found that the approximate dose is 1 gm. to every 10 pounds (4.5 kg.) of body weight and has had enteric tablets of 1 gm. each made up which are now on the market, but I have obtained results with both the solution and the capsules as illustrated in the following cases:

Case 1.—Massachusetts General Hospital; S. L., aged 20, a man, white, single, an order clerk, April 16, 1921, fell 3 feet (0.912 meter) from a freight elevator. He was not unconscious; he had a slight dizziness for one day, then a frontal headache came on which was not severe but constant. There was no ringing in the ears. The patient had a small clean wound on the back of the head; there was no swelling and no surrounding tenderness.

The pupils were equal and reacted to light and distance. There was no nystagmus; the fundi were essentially negative. The tongue protruded in midline. The knee and ankle reflexes were equal and active. The plantar reflexes were normal. Sodium chlorid was prescribed, ½ dram (2 gm.), in water three times daily.

April 18, 1921: The patient felt better for about three hours after taking salt. The headache was relieved but returned gradually. Sodium chlorid was administered, 1 dram (4 gm.), in water, every four hours. April 20, 1921: The patient had no headache except a little after riding on a street car on the way to the hospital. He was advised to return to work. Sodium chlorid was administered, 1 dram three times daily, for one week then twice daily for one week. May 4, 1921: The patient's condition had improved. He had no headache; he lived an outdoor life. May 18, 1921: He had no headache and no nerve lesion. Dec. 12, 1921: The patient was entirely well; the headache did not return.

Case 2.—Massachusetts General Hospital; R. M., aged 14, a white schoolboy, Nov. 22, 1921, about two months before presentation, fell from a team and struck the back of his head and neck. He said that he was all "mixed up" and out of his head immediately after the accident but his condition rapidly cleared up. Two weeks later he "went out of his head" and has been irrational ever since. He is now mentally retarded. He responds slowly to questions and is very deliberate in speech and movements. He has no convulsions. He complains of headache. He is said to have been normal before the accident. There is no external evidence of injury to the skull or spine. A roentgenogram of the skull and spine was negative. There were slight venous congestions of the fundi; there was no choked disk. He had diplopia, but it was not constant. One-half dram sodium chlorid (in capsules) was administered four times during the day and night. Nov. 23, 1921: The patient was brighter and responded to questions very well. He said that he had a dull headache, but it ceased after taking salt. One-half dram sodium chlorid was administered three times daily. The dose was gradually reduced in one week to once daily. Nov. 29, 1921: The patient did not have headache. The fundi were negative. He received one-half dram of salt three times a day. Dec. 6, 1921: The patient was improving; he had no headache; he was still a little slow in responding to questions. Continued salt administration, one-half dram in the morning. Dec. 13, 1921: The patient had no headache. Salt administration was discontinued. Dec. 15, 1921: No salt was given. He complained of numbness in the head; he responded poorly to questions and appeared quite disturbed. 8:30 p.m.: The patient was given salt by mouth; at 9:30 he had quieted down slightly but was still quite disturbed. Salt was discontinued too soon.

DISCUSSION

Dr. F. J. Farnell: Probably some of the members of this Society recall a case of oidiomycosis presented by me about three years ago. The patient showed lesions on his chest and spinal column. He was treated with potassium iodid. It required 400 grains (26 gm.) of potassium iodid a day to keep his disease in check. The man finally recovered and lived until about a year and a half ago, dying from pneumonia. His family physician said emphatically that the man did not have the oidiomycotic infection at the time of his death. The percentage of potassium iodid that the man was taking led me to feel that it might be possible to attack the problem in a different manner. The next case coming under my observation was at the State Hospital. I made a 25 per cent. solution of potassium iodid and gave him 200 c.c. intravenously. Within a few days the man improved and gradually recovered. He is perfectly well today and shows no evidence of his disease so far as known. At that time he had skin lesions as well as a cerebrospinal disorder. Last April a child was brought to me with this disease. I gave her a 10 per cent. solution and all lesions subsided immediately. The use of hypertonic sodium iodid solution intravenously as applied in fungus disease naturally led me to feel that it might be used for other purposes, and for two years past I have been giving hypertonic sodium iodid intravenously to three types of patients: first, to those with oidiomycosis, which cases are cleared up almost immediately; second, to those with the meningitic and meningovascularis forms of syphilis. These are treated with a 10 per cent. solution of sodium iodid intravenously followed by arsphenamin. Third, to those with hyperemic headache, not the headache due to a blow but that which occurs periodically and which is so severe as to keep the patient in bed for two or three days—the type that manifests complaints of an ocular type. A series of patients with hyperemic headaches have responded immediately to a 10 per cent. solution of sodium iodid. The usual procedure is to give intravenously 100 c.c. of a 10 per cent. solution of sodium iodid every five days (made up fresh).

Dr. W. J. Mixter: I am naturally very much interested in this subject from the surgical point of view. We tried the use of hypertonic salt solution intravenously in a small series of severe cranial injuries without much effect. They were all severe and some of them were complicated cases. My own feeling is that the main effect in the traumatic case as in any other type of case treated with hypertonic salt solution is on the cerebrospinal fluid, and that there is probably comparatively little effect on the brain. The work that Dr. Mella is doing should be followed out in a larger series of cases and in the more severe type of concussion, if possible, the type in which the patient is kept in the hospital. I feel that severe concussion is definitely a subject for hospitalization and cases can probably be followed there better than in any other way. We must remember that there is a definite rebound after the use of hypertonic salt solution, and we must be careful that our rebound is not enough to give us increased symptoms. Looking back fifteen or twenty years we find that one of the prime requisites in the proper treatment of concussion in this hospital was the most active purgation by salts. That method was dropped about the time I was house officer as being empirical and probably of no value; I doubt that it has been carried out at all during the last few years. I believe that such purging had the same effect as the salt solution.

Dr. Donald Gregg: Hypertonic salt solution in the form of Epsom salt has been used by most of us for years with some success, possibly only transient, in three kinds of cases—headache, acute alcoholism and epilepsy. Perhaps, instead of lessening "autointoxication" or some other unproved condition, we have been dehydrating the central nervous system a bit. Possibly also, the new treatment of epilepsy by starvation obtains results by a similar physiologic method.

THE SPINAL FLUID IN MULTIPLE SCLEROSIS. Dr. H. B. Foster.

Dr. Foster gave a preliminary report on his laboratory work with the cerebrospinal fluid in multiple sclerosis. He said that the thirty-eight cases had been selected with due caution. The fluids all presented a negative Wassermann test. The cell counts were from normal to a marked increase (50 per mm.). The total protein content, quantitatively determined by the Denis-Ayer method, was from normal to nearly three times normal. In a relatively small number of fluids a globulin ring with ammonium sulphate was present. The colloidal gold solution test gave a curve in the so-called (misnamed) paretic zone in half of all the fluids. However, if only those cases showing a progressive activity, clinically, were grouped together, the percentage giving this zone curve was considerably higher. The sugar, nonprotein nitrogen, urea, uric acid, creatinin, acetone bodies and chlorid content were well within the normal limit of range. Blood correlations were made performing the biochemical tests enumerated in the foregoing, and the results were all within normal limits, with one exception. The blood Wassermann reactions were also negative. The noteworthy feature of the laboratory findings in the cerebrospinal fluid from patients with multiple sclerosis, then, is the seeming approach to a normal fluid, the colloidal gold solution curve being a frequently occurring exception.

(The full report of this work was given before the Association for Research in Nervous and Mental Disease in New York, Dec. 28, 29, 1921. This report will appear in the Archives of Neurology and Psychiatry.)

BULLET WOUND OF THE BRAIN. Dr. E. W. Taylor.

The following case is reported because of the unusual sequence of events in its course, especially the relation of trauma to what appeared to be epilepsy, the relief of epileptiform attacks by operation and the subsequent production of a hemiplegia with partial hemianesthesia and possibly symptoms relating to the thalamus.

The patient, a man of 32, stated that he was accidentally shot at the age of 5, the bullet lodging in the brain somewhat near the surface. No operation was performed, he made a good recovery, became a ship mechanic, was admitted to the Army, and worked in a ship yard. While at this work in November, 1916, he fell a distance of from 40 to 45 feet (12.16 to 13.68 meters) and became unconscious but was not paralyzed. Thereafter he had severe headache and in the latter part of the month in which he was injured an epileptiform attack with apparently definite loss of consciousness. These attacks increased greatly in frequency and finally led to operation which resulted in the removal of part of the bullet but unfortunately with a resultant hemorrhage which destroyed a considerable portion of the parietal region of the brain on the right. From this developed a severe left hemiplegia, naturally without aphasia. The epileptiform attacks ceased and he has had no recurrence or headache in spite of the destruction of brain tissue following operation. He later developed a slight hemianesthesia and sudden attacks of pain which pointed somewhat toward the thalamus. His condition has not materially improved in spite of assiduous treatment.

DISCUSSION

Dr. W. J. Mixter: This patient at operation showed a simple cyst and about it the fragments of the bone to which a considerable fragment of lead was firmly adherent. On loosening the indriven fragment of bone, which measured 3 or 4 cm., there was profuse bleeding from one of the arteries of the brain which had to be checked with a tie and packed. The result was paralysis which is now present. I think this shows clearly how extremely little damage to the brain will cause a rather severe type of palsy. I had no idea that he would have left-sided paralysis when he came out from under the influence of the ether. It was impossible at the time of operation to remove the other fragment of lead which is still in place. I think one of the interesting points in this case is the fact that the patient has had no epileptic attacks since operation. Whether they will recur or not is a problem.

Dr. J. B. Ayer: To what were the epileptic attacks due?

Dr. W. J. Mixter: The attacks were probably due to the cyst and the indriven pieces of bone.

NEW YORK NEUROLOGICAL SOCIETY

The Three Hundred and Ninety-Third Regular Meeting, Jan. 3, 1922

Foster Kennedy, M.D., *President*

CHEMISTRY OF PHOSPHORUS IN BRAIN ACTIVITY. Presented by Dr. William H. Porter.

Phosphorus in combination with soda serves the physiologic economy in three distinct processes: (1) In connection with the digestive functions the trisodic phosphate is acted on by the hydrochloric acid and converted into (2) a disodic monohydrogen phosphate which is the true alkalinizer of the body fluids and tissues. A high state of alkalinity is essential to perfect oxidation and assimilation. (3) After the disodic monohydrogen phosphate has served its purpose in the body it is excreted through the kidneys, where it meets a molecule of uric acid and is transformed into the acid monosodic dihydrogen phosphate, the true acidifier of the urine.

Phosphorus is found also in combination with calcium, magnesium and potassium, the sodium and calcium combinations being most important. Phosphorus also reaches the body fluids and tissues in the form of lecithin, nucleoalbumin, nucleic acid, phytin, etc. Phosphorus enters plant life as a phosphate to be synthesized into these highly complex bodies.

My contention for years has been that oxidation reduction takes place only in the fixed cells, as found in the various body glands, and not in the body tissues and fluids; and that this process constitutes, in a large measure, the biologic activity of the body cells. In connection with these oxidation reduction processes and the exact place where they occur, it should be remembered that the ganglion cells of the nervous system are large masses of protoplasm resembling in composition, but not in shape, the cellular structures of the glandular organs, and that, in all probability, they are the place at which the complex phosphorus-bearing bodies are oxidized and reduced.

The reasons for this interpretation are that these protoplasmic masses are abundant in the central nervous system; that these phosphorus-bearing compounds are found in larger amount at this point than in any other parts of the body, and that there seems to be a decided generation of impulses originating in the central nervous system which control and regulate the automatic balance of the human system—a condition which could not be maintained if the nervous energy was due solely to reflected heat energy brought to the central nervous system by the centripetal nerves and reflected out again by the centrifugal nerves. Active working of the central nervous system is always accompanied by increased elimination of alkaline phosphates, which fact tends to support the theory that these phosphorus-bearing bodies are oxidatively reduced in the cells of the central nervous system. Hence, increased elimination of the alkaline phosphates indicates simple augmented physiologic activity of the nervous system; and overelimination of the earthy phosphates in a highly acid urine indicates a malnutrition involving chiefly the nervous mechanism.

The answer to the question as to how these complex phosphorus-bearing bodies can be converted into energy and phosphates, and how they pass out of the system, is plain if the theory be accepted that the protoplasmic masses of the central nervous system have the power oxidatively to reduce this class of bodies. Assuming that the nerve cells possess this power, lecithin, for instance, is here reduced to phosphate of soda, urea, carbon dioxid and water.

It is recognized that bone deficiency is not due to lack of lime salts or bone-producing elements, but to disturbance of metabolism which prevents fixation of the calcium salts. In the reduction of the phosphorus-bearing molecule it is reasonable to suppose that, for an instant, the phosphorus atom is free and exerts this oxidative stimulating action on the protoplasmic masses, thus generating an inherent central nervous impulse, which not only augments the cell activity per se in which this change occurs, but is reflected to all parts of the economy by the nerve fibers springing from the cells.

So far as known to the author, the production of disodic monohydrogen phosphate from these complex phosphorus-bearing compounds is a newly revealed fact, and gives to the physiologic economy an inherent source of this absolutely essential body alkalinizer. How much is produced in this manner daily is not known.

A CASE WITH THE CLINICAL PICTURE OF MIDDLE FOSSA TUMOR: NECROPSY FINDINGS. Dr. E. D. Friedman.

John C., 11 years old, an Italian, admitted Nov. 13, 1921, to Bellevue Hospital. died Dec. 11, 1921. The family history was negative. His delivery and development had been normal. His present illness began from five to six months ago with attacks of headache lasting about one day and occurring once a week. His condition remained unchanged for three and a half months. He then became bedridden, being unable to walk. Three weeks prior to his admission to the hospital he became drowsy and had nose bleed; the right eye became blood-shot. Weakness of the right side of the face developed. There was no fever at any time. Three weeks ago at the onset of one of his attacks he was unconscious for a short time. His headache became constant, but there were no bladder or rectal symptoms. He had complained of pain in the right side of the face and of double vision. Physical examination revealed an emaciated, pale boy, with a dry skin, with no abnormal medical findings. He was irritable and cooperated poorly in the examination. The right pupil could not be examined, due to local conditions in the eye. The right fundus could not be seen; the left showed slight venous congestion. The left pupil was large and reacted poorly to light and accommodation. There was ptosis of the right upper lid and exophthalmos, with limitation of ocular movements in the horizontal plane, more on the right; anesthesia in the distribution of the right fifth nerve and slight weakness of the right seventh of the lower neuron type. Hearing was normal. The tongue deviated slightly to the right. The abdominal reflexes were normal. The knee reflexes were absent; the ankle reflexes were present. There was no Babinski sign, although the left plantar response was at times equivocal. Kernig's phenomenon was absent. There was generalized wasting with hypotonia. There was no ataxia. Sensation as far as could be tested was normal. There was no evidence of sinusitis. The spinal fluid was bloody and under increased pressure. The Wassermann test was negative in both blood and spinal fluid. The roentgen-ray examination of the skull showed evidence of increased intracranial pressure, the coronal and lambdoidal sutures being pronounced. Erosion of the posterior clinoid processes was present. The floor of the sella was depressed. The white cell count was 10,400, with 5 per cent. polymorphonuclear cells. The Pirquet test was negative. Operation was refused.

The postmortem findings in the skull were as follows:

Brain: The calvarium was removed without difficulty and was somewhat thin. The dura stripped readily. The brain appeared large for a child of 11 years. The convolutions were somewhat flattened on both sides. The brain was removed with difficulty. At the base of the brain there was an irregular mass of material which seemed somewhat friable and contained plaques varying in size, most of them about 1 mm. in diameter. This tissue was spread over the brain stem, the pons and the pyramids and extended backward to the cerebellum and into the interpeduncular space; it appeared to be attached to the tissue filling the sella. On opening the latter it was found to contain a mass of tissue which was somewhat blood stained and mixed with blood clot. The latter extended forward into the ethmoid cells on the left, but there was no communication with the nasal cavity on the other side. There was marked erosion of the sella, also of the torcula. There were small areas of erosion over each temporal bone. There were one or two plaques on the lateral surface of the cerebral hemispheres.

The right orbital fossa was somewhat large. On dissection of the right eyeball it was seen to contain an increased amount of vitreous humor; otherwise it appeared normal. The final pathologic diagnosis has not yet been made.

The dominant findings in the case are those of middle fossa lesion on the right (ocular muscle palsies, anesthesia in the distribution of the fifth with resulting neuroparalytic keratitis and conjunctivitis). There were slight evidences of extension of the process posteriorly (peripheral facial palsy and slight deviation of the tongue). There was also an apparent lesion of the internal fibers of the third nerve on the left, but the findings, with the exception of those pointing to the lesion of the right middle fossa, were meager indeed when one considers the widespread character of the lesion. It is worth noting that there was no evidence of choked disk. This may have been due to the yielding of the sutures noted in the roentgen-ray report. That intracranial pressure was increased was shown by the roentgen-ray findings in the skull, the increased tension in the lumbar fluid, and possibly also the diminution of the knee reflexes. The last is commonly seen in cases of hydrorrachia. The alternative explanation for the diminution of the patellar reflexes, that of possible injury to the cerebellar pathways, could not be demonstrated, although there was noted hypotonia of the musculature. The bleeding from the nose on the right side led to the consideration for a time of cavernous sinus thrombosis, but this diagnosis was rapidly abandoned. The protrusion of the right eyeball was not adequately explained by the necropsy findings, but it has been noted frequently in middle fossa tumors and may be due to irritation of the sympathetic filaments which innervate the so-called Landstroem muscle surrounding the eyeball.

DISCUSSION

Dr. Foster Kennedy: Although Dr. Friedman explained the diminution and absence of deep reflexes in this case as due to the increase of intracranial pressure there was no great evidence of this or of traction on the posterior spinal roots at any time. The tumor has the appearance of a multiple sarcomatosis.

CASE OF INTERNAL COMMUNICABLE HYDROCEPHALUS BEARING ON RECENT EXPERIMENTAL WORK. Presented by Dr. I. Strauss and Dr. J. H. Globus (the latter by invitation).

The patient, a 3 months old child, weighed 6½ pounds (about 3 kg.) at birth, after which the head became progressively enlarged. The child had club feet, the legs were held flexed and in contracture, the arms moved freely. Fluid was removed from the ventricles, and after the removal the fontanelles remained depressed. The child was apparently blind.

The brain exhibited a marked degree of internal hydrocephalus. The cortex of both cerebral hemispheres was reduced to paper thickness. The pons, medulla and basal ganglions appeared normal in size. An India ink injection was made after death into the pontocerebellar system, and the injection went forward as far as the chiasm and covered the cerebellum and the midbrain. None of the injected fluid reached the surface of the hemispheres, nor did it enter the ventricles. An examination of the meninges revealed no evidence of an inflammatory process. It therefore appears that the obstruction in the subarachnoid space was a developmental defect.

Sections through the midbrain also showed rudimentary remains of the aqueduct of Sylvius, so that this case was both an obstructive and communicable type of hydrocephalus.

TERATOID CYST OF THE HYPOPHYSIS (PATHOLOGIC MATERIAL AND LANTERN SLIDES). Presented by Drs. J. H. Globus and I. Strauss.

The tumor presented showed in addition to the uncommon histologic structure, features of clinical significance. It occurred in a girl, 6 years of age, who had had no previous illness and who had been quite normal up to the time of the onset of symptoms, six months before admission to the hospital. At that time she became restless, markedly constipated, lost her appetite and developed polydipsia and polyuria. Several weeks later, the diagnosis of diabetes was made, and she was treated accordingly. A week before admission to the hospital the child's mouth was drawn to one side and her left shoulder dropped and frequently twitched. She was admitted to the hospital with the complaint of headache, fatigue, excessive thirst, enuresis, loss of appetite and weakness of the left shoulder.

Physical examination showed a fairly well nourished child, somewhat undersized, with a profuse growth of lanugo hair all over the body. There were found: ptosis of the right eyelid, weakness of the right internal rectus: the left pupil was larger than the right with both pupils reacting to light and accommodation. There were also left facial weakness, slight weakness of the left arm and hand, and slight weakness of the left leg. The deep reflexes were more active on the left side, though generally reduced. Gait and station were normal. The abdominal reflexes could not be elicited. The spinal fluid was negative as regards cells and the Wassermann reaction. The diagnosis of neoplasm involving the posterior lobe of the pituitary and the right crus cerebri was made.

At necropsy a large purple fluctuating mass was found at the base of the brain. It covered the optic chiasm and was adherent to the latter. Posteriorly it filled up the entire interpeduncular space. Its bulging inferior surface, which was partially free, was prolonged into a funnel-shaped process which seemed to be continuous with the pituitary body. The latter was small in size and compressed, and was lodged in a shallow and eroded sella turcica. The base of the superior surface of this mass was firmly implanted in the substance of the basal surface of the brain. It occupied the entire interpeduncular space and, because of pressure on the adjacent structures, the optic chiasm and the optic tracts were flattened. The tuber cinereum and the mammillary bodies could not be identified since the floor of the third ventricle was stretched and flattened by the tumor mass which almost obliterated the cavity of the third ventricle by its protrusion into it. The cerebral peduncles were displaced laterally and, due to pressure, were reduced in size, this being more pronounced on the right side. The neoplasm, which contained a dark brown, granular, semifluid mass, was a rather thin-walled cyst, lined by a corrugated membrane which was studded with numerous small, glistening elevations. The cyst, which was 4 cm. long, 3.5 cm. in width, contained cholesterin crystals. It pressed on and flattened both of the optic nerves and the right oculomotor nerve. A horizontal, longitudinal section of the brain showed the cavity of the cyst fully exposed and that, at the left of the anterior portion, its wall was thickened, giving rise to a tuberous elevation cartilaginous in consistency and somewhat translucent in appearance.

The wall of the cyst was for the most part of a uniform thickness and histologic structure, and was composed of three layers. The innermost coat, a layer of stratified squamous epithelium showed at a few points a little variation in the character and maturity of its epithelium. The middle layer consisted of loose connective tissue in which were imbedded numerous glandular acini and many small ducts. The glands appeared to be salivary in character, and the ducts were lined by tall cuboidal epithelium and filled with a pink staining colloidal substance. The third and outermost layer was composed of a fairly thin stratum of dense fibrous connective tissues forming a boundary between the brain tissue and the cyst and serving as the outer protective wall of the exposed part of the cyst.

The lining epithelium showed its strong resemblance to the epithelium of the dermis of a young embryo by its three layered formation and by the presence of hair germs. Again accumulation of deeply staining epithelial cells in concentric layers gave rise to structures not unlike epithelial pearls. The cells in the center of these pearls appeared to undergo degeneration, the peripheral cells having retained the structure of basal cell epithelium and showed, when stained specifically, the characteristic intercellular bridges and keratohyaline granules. In the small cartilaginous mass were found several types of embryonic tissue of mesodermal origin, such as embryonal cartilage mucous connective tissue, young fibrous tissue, newly formed bone with typical bone corpuscles, calcified trabeculi, endosteum and periosteum crowded with numerous osteoclasts, osteoblasts, osteophites, and marrow cells filled with yellow granules, which on staining with specific methods gave a typical iron reaction. In addition to these structures, there was a collection of cells arranged in long cords and supported by a fine reticulum, which contained fat and in general strongly resembled cells in sebaceous glands.

The unusual histologic features of the tumor place it among a rather small group of neoplasms, which recently through the work of Erdheim have been traced to misplaced embryonal remnants of the subinvoluted craniopharyngeal duct, though such cysts in the past have been variously described as cholesteatomas, dermoids, epidermoids and occasionally, because of the occurrence of cartilage and bone in their walls, as teratomas.

The confusion in the classification of such cystic neoplasms was due to the fact that some coincidental findings, such as cholesterin crystals, bone or cartilage were accepted as basic and fundamental features of such tumors.

It is most probable that the various tissues found in the neoplasm described were derived from the two germ layers, ectoderm and mesoderm, which make up the mature skin. It is then assumed that the cyst described is a teratoid growth, autochthonous in origin, which was formed by an embryonal misplacement of cells from the two germ layers during the period of the invagination of the ectoderm and in the course of the formation of the hypophysis.

The gross anatomic relations of the tumor to the hypophysis and to the structures in the floor of the third ventricle are of significance in view of the clinical manifestations pointing to a disturbance of pituitary functions. This is particularly true in the light of recent experimental works by Baily and Bremmer, who have shown that the clinical symptoms of diabetes insipidus, such as polydipsia, polyuria and cachexia can be provoked with certainty by a lesion produced in the postinfundibular region of the hypothalamus, while the complete removal of the posterior lobe of the hypophysis does not lead to permanent production of such symptoms.

The tuber cinereum, the mammillary bodies and in fact, the entire floor of the third ventricle was almost completely destroyed through pressure by the tumor mass, while the infundibular portion of the hypophysis showed no change except compression. It would appear that the findings in this case serve to support the results of the experimental work of Baily and Bremmer.

THE BIOLOGIC INTERPRETATION OF PSYCHONEUROSIS. Presented by Dr. L. Grimberg.

Every psychoneurotic person, if carefully examined, shows some endocrine disturbances as evidences of endocrine maldevelopment. This condition is a prenatal state and forms an organic inferiority, which means that the person in question is a vulnerable person and under certain circumstances will develop a psychoneurosis. The present classification of psychoneurotic persons is made entirely from the psychologic point of view. Even if the freudian theory is accepted, the psychoneurotic person is conceived as a result of a conflict going on in the individual in question, and the compensation which arises in the form of a psychoneurosis is a result of psychologic maladjustment. On the other hand, a person cannot be conceived as an entity. It is erroneous to look at him otherwise than as a sociologic unit. His illness is defined not so much by his mental state as by his mental attitude. The psychoneurosis is manifested by the relations between the person and other people. It is exactly that point which has been overlooked in the study of psychoneurosis, and the importance of the milieu in the production of psychoneurosis must be considered if we intend to reach to a proper understanding.

Based on the theory of Weissmann (on heredity) every normal person is born with the potentiality to reach the stage in which his parents are and also with the potentiality to overreach that stage. (That determines progress.) This will explain the appearance of atavism, because there it is possible that the molecular structure of the germ cell may be so changed that regression is taking place.

I will explain the nature of the conflict which takes place between the conservative elements transmitted by heredity—egotism and the milieu. The milieu represents all that surrounds the person. Sociologically it is society. Society is formed by conscious elements, but the resultant is not a conscious entity. On the other hand, this resultant of all the conscious elements—society—represents an equilibrium between the conservative factor transmitted by heredity (egotism) and the revolutionary factor (altruism). The normal person is born with the potentiality to reach that compromise, or equilibrium of the social entity from which he springs.

A classification of the psychoneuroses, based on the study of this conflict, will give us a more reasonable and plausible explanation of the appearance of psychoneurosis. Some of the classes of psychoneurotic persons are:

(1) Persons born without the potentiality of compromise. They are usually the amorals of Lombroso, the criminals and sexual perverts.

(2) Persons born with the potentiality of compromise but at the same time the milieu, which comes into conflict with them at the start, like the family, is not in compromise. The result is that egotism instead of shaping itself becomes more pronounced. Or the person is developed into a personality with an exaggerated ego, though with the potentiality and though the milieu is in compromise, but due to various causes, like the only child.

(3) Persons who at one time in a certain milieu were in compromise, but then came into a different milieu and the conflict started anew. As examples we have the racial psychoneuroses in our country.

DISCUSSION

Dr. Russell G. MacRobert: I would like to ask whether Dr. Grimberg really considers emotional stress or strain, such as fright, grief, worry and chagrin, less important than the character of the glands of the person in determining a psychoneurosis?

Dr. Foster Kennedy: Dr. Grimberg's subject embraces so wide a field it would not be possible to discuss it properly in so limited a time. He defines a psychoneurotic as being a person in constant reaction with his milieu. I do not quite know what he means by the use of the word "reaction." If he means conflict with his milieu I can understand it; but reaction is not necessarily conflict. After all, the whole process of life is one of reaction to the milieu, and that is a perfectly normal situation; not at all the abnormal condition of emotion suggested by the use of the word psychoneurosis. Again, Dr. Grimberg said that egotism was unknown among the lower animals. In what sense did he use the word egotism in that remark?

Dr. L. Grimberg: I use the term egotism in the sense we use it in ethics. I mean conscious sacrifice. Of course there is such a thing as egotism among lower animals. About the other questions, I did not say definitely that the endocrine glands have any importance at all. I made the remark that they might show an organic inferiority of the person. About the reaction I expressed myself badly. I really did mean that the psychoneurotic person is in a continuous state of conflict with his milieu.

SAN FRANCISCO NEUROLOGICAL SOCIETY

Twelfth Regular Meeting, Jan. 13, 1922

M. B. Lennon, M.D., *President, in the Chair*

PSEUDOTUMOR OF THE BRAIN. Presented by Drs. H. C. Naffziger and G. Y. Rusk.

An Italian, aged 43 years, five years ago began to complain of failing vision, followed by paresthesia of the right side of the body and face. His hearing also became involved, first on the right side and later on both sides. At the same time he suffered with severe frontal headaches for several months, with nausea and vomiting. Three months before admission to the University Hospital he had diplopia, his gait was stumbling and he had occasional dizzy spells. He was mentally confused and his memory was poor.

Physical examination showed that the pupils were equal, regular and reacted to light and distance. The fundi showed swelling of both disks and obliteration of the disk outlines. There was a homonymous hemianopsia and right internal strabismus. The deep reflexes were exaggerated; urine examination was negative, as were also the blood Wassermann and spinal fluid tests. The blood count was normal.

The final decision in this case was a midline growth, but an exploratory operation failed to reveal a pituitary tumor.

Necropsy examination, limited to the brain alone, showed an extensive hemorrhage in the right frontal lobe which was the cause of death. No evidence of the tumor was found. Cutting into the left optic radiation from the ventricular side was a chronic lesion, soft and yellow, which on microscopic examination contained many compound granule cells. On the other side, almost symmetrically placed, was a smaller lesion, apparently a somewhat older process. Section through the pons showed another little focus of softening. In the latter region microscopically could be seen vessels completely occluded. Undoubtedly these foci were embolic in origin. There was no history of heart disease or pulmonary condition which might account for the emboli, however. It is interesting in this case that there was choking of the disks. There was no evidence of chronic syphilis to account for the headaches. While the roentgen ray apparently showed almost complete destruction of the anterior clinoids and some erosion of the posterior clinoids, necropsy failed to substantiate these findings.

DIFFUSE CEREBRAL SCLEROSIS. Presented by Dr. G. Y. Rusk.

The patient was an infant of 17 months; a full term child, whose birth was normal, although labor was prolonged. The first tooth appeared at 9 months, and the fontanels closed at 9 months. The child never sat up, never talked and never recognized its mother. There was no reaction to light or sound.

All the reflexes were exaggerated and examination revealed general spasticity. The right leg suddenly became flaccid three weeks prior to death. All laboratory reports were negative.

At necropsy there was found marked external hydrocephalus. The brain showed marked general atrophy. The cortex was universally firm; the convolutions narrow and the sulci wide. Considerable pressure with a razor blade had to be used in order to cut out the sections. The basal ganglions were relatively normal in size. Numerous sections were taken from one hemisphere and the cord. The flaccid paralysis was explained by a definite ventral horn lesion—histologically, anterior poliomyelitis, Cortical sections showed that the nerve cells were relatively greatly reduced with diffuse glial hyperplasia.

To summarize: The condition was a diffuse sclerosis affecting the cortex, while the basal ganglions were relatively intact. Likewise the changes in the cord appeared to be largely secondary to the cortical changes. Necropsy of the lungs showed subacute miliary tuberculosis, and the inflammatory focus in the ventral horn might have been an early embolic tuberculous process.

BRAIN TUMORS WITHOUT MANIFESTATIONS OF INTRACRANIAL PRESSURE. Presented by Dr. H. C. Naffziger.

(A report from the division of neurological surgery at the University of California Hospital on brain tumors without manifestations of intracranial pressure.)

There were presented seven consecutive cases, in all of which two years had elapsed since operation. The economic status of these after operation was given and compared with the results of operation in cases showing ophthalmoscopic and other signs of intracranial pressure at the time of operation.

All of the patients in the cases reported have returned to the same work they did prior to operation. Four of them had complete tumor or cyst removals. All of these but one had been incapacitated for work prior to treatment. Of the seven two had infiltrating tumors of the motor region. These were reported in detail.

A man, aged 48, presented paralysis of the left arm and leg with striking atrophies of these extremities. He had jacksonian and general convulsions. Following a radical removal of the growth—an infiltrating glioma 4 by 4 by 2 cm. —power gradually returned in the formerly paralyzed extremities. In six months this patient returned to manual labor and has now continued work for two years without signs of a recurrence. The general convulsions have ceased, and infrequent minor attacks have been controlled with phenobarbital (luminal). The second patient, a man aged 35, presented a complete paralysis of the left arm, with jacksonian attacks. Following a radical removal of a glioma of the small cell type measuring 3 by 2.5 by 1.5 cm., power began to return in the arm in three weeks. In eight months all movements could be performed. The grip became 75 per cent. of normal. There was some awkwardness of the finer hand movements, but this was barely noticeable. This patient has been at work as a contractor for over one year.

The absence of any operative mortality in this group of cases, an average post-operative hospital stay of three weeks, and the restoration of all patients to positions as wage earners is a striking improvement over the results in a far larger group of tumor cases in which the patients first presented themselves for treatment with marked pressure manifestations. Concerning the two having radical removals of gliomas with a margin of normal tissue it is appreciated that the time is too short to indicate permanent cure. With small infiltrating growths radical removal is advocated and a location of the growth in the motor region is not considered a contraindication to this removal. A comparison of successive groups of tumor cases treated which shows an increasing proportion of persons restored to a measure of usefulness is an index of progress in diagnostic and operative treatment.

CHICAGO NEUROLOGICAL SOCIETY

Regular Meeting, Jan. 19, 1922

LEWIS J. POLLOCK, M.D., *in the Chair*

A CASE OF DYSTONIA MUSCULORUM DEFORMANS. HUGH T. PATRICK.

This boy of German-Scotch, not Jewish, parentage, nearly 11 years old, was one of twins born at full term after normal labor and no asphyxia. The family history was negative except that the twin brother died at 6 years of a cerebellar glioma. The patient was the larger twin but developed slowly, not talking plainly until 3 years or older. He walked at the proper age and normally until his present trouble began. Progress in school was retarded, partly on account of his present trouble. His mental age was about 8. He had the ordinary diseases of childhood and vomited frequently until the age of 4.

When about 6 it was noticed that he walked and ran peculiarly. In the early summer of 1918, when between 7 and 7½ years of age he began to walk and stand with the body bent forward, due chiefly to flexion of the trunk on the thighs; this was his attitude when I first saw him, Oct. 8, 1918. He was then 7 years and 8 months old. This stooping varied in degree but was constant, and in walking he generally supported the trunk by pressing the right hand against the thigh. But not only could he walk and run without so supporting himself, he could also stand quite straight and walk and run well and normally erect. Two months before blood Wassermann tests on the boy and the mother had been negative. I could make no diagnosis. For two weeks the boy had been having headaches and one naturally thought of brain tumor, but all the ordinary signs were lacking. All extremities were rather clumsy, more so on the right, but the results of examination were practically negative.

I did not see the patient again until Jan. 3, 1922. In the meantime he had been examined by three neurologists, two pediatricians and an internist, and another Wassermann test had been negative. No one made a diagnosis of dystonia musculorum. In July, 1919, one of the neurologists is said to have made a diagnosis of hysteria and cerebral palsy. The boy was sent to a relative in the country and is said to have improved, but by December, 1919, was again worse, stumbling and often falling. In January, 1920, the neurologist saw him again, reaffirmed his diagnosis, and the boy again went to the country. With more or less fluctuation in his condition he gradually grew worse. Since the middle of October, 1921, he has had difficulty in sitting and for about two and a half months has not been known to sit. When he attempts to do so, the trunk stiffens, then curves backward, the thighs, especially the right, are rigidly extended, the feet twist and if he persists in the attempt eventually he slides from the chair to the floor (Fig. 1). Consequently he stands all day; but he cannot stand quite still; there is a constant slight or moderate writhing movement of the trunk which tends to hyperextension, a little swaying ,and constant unobtrusive shifting from one foot to the other: The arms, too, are in almost constant, slow, slight, restless, rather vermicular movement (Fig. 2).

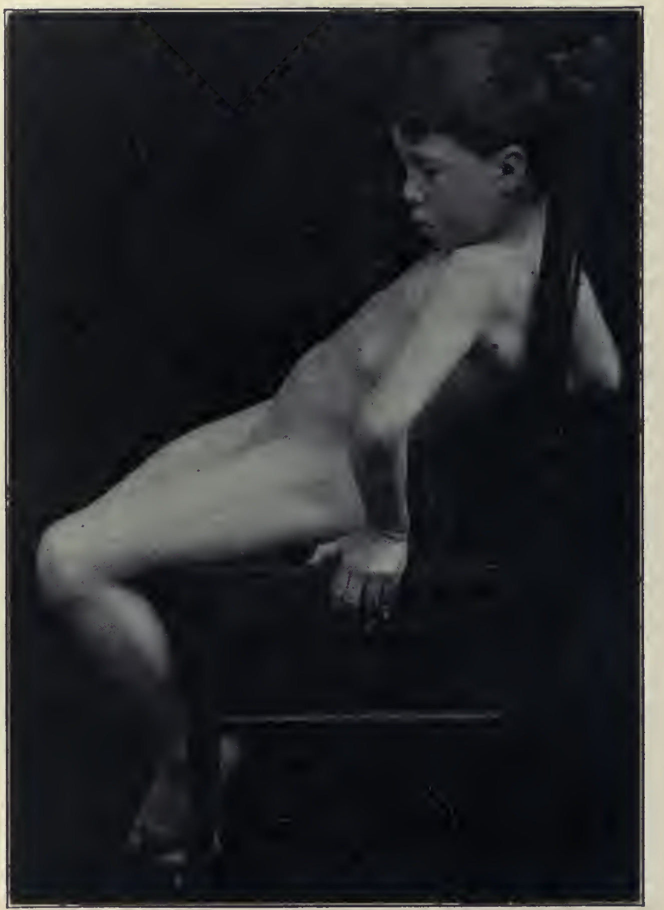

Fig. 1.—Attempt to sit upright.

For six or eight weeks the boy has been unable to lie down. When he tries to do so the body and limbs stiffen; there are the rather slow writhing movements; the tonic spasm becomes severe; the face flushes; respiration is more shallow and irregular, and gradually he becomes opisthotonic (Fig. 3). Consequently he sleeps in a most bizarre attitude. He kneels in bed, places a pillow between abdomen and thighs and stoops forward until the head rests on another pillow (Fig. 4). Often after going to sleep in this posture he

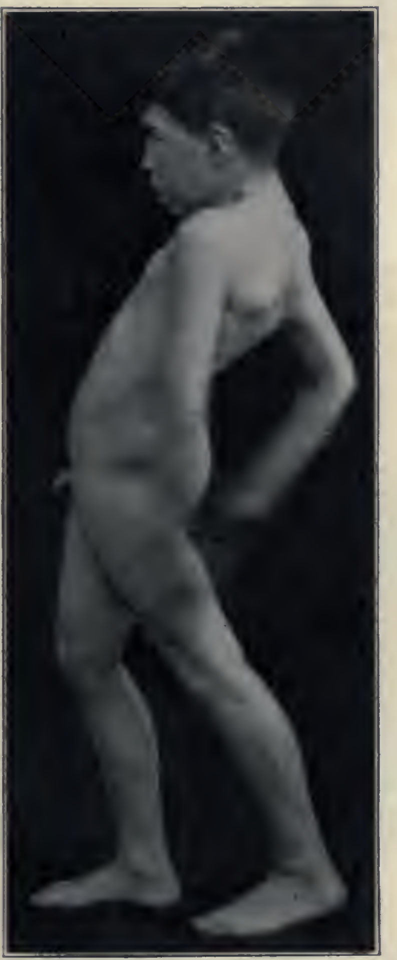

Fig. 2.—Attempt to stand upright with feet together.

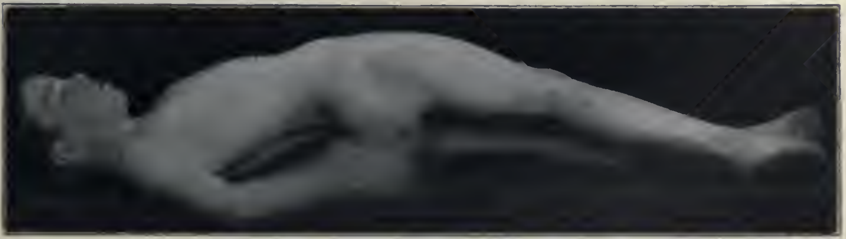

Fig. 3.—Attempt to lie on the back.

falls onto the side and continues so to sleep if undisturbed. At first the mother would try to straighten him, the spasm would return and he would again have to assume the kneeling posture to go to sleep.

In spite of the intense opisthotonic spasm, when I quickly turned the boy onto his side I was easily able to flex thighs and legs. It is such peculiarities as this which often have led to a diagnosis of hysteria. However, this flexion lasted only a moment; the extensor spasm quickly reappeared.

In spite of these peculiar disabilities he can walk well and even run well and does all the ordinary coarser things with the hands: feeds and dresses himself. When asked to stand and stretch out the arms in front of him with fingers spread, he showed slow, very spastic, rather athetotic but slight irregular movements of the arms, forearms and fingers; the trunk muscles contracted more on the right and the right buttock more than the left.

The patient complains a good deal of headache, principally on the right side but otherwise is cheerful, of good disposition, amenable, eats well and complains very little of fatigue.

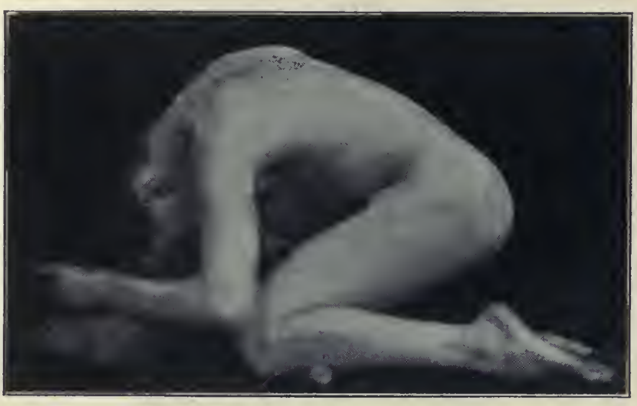

Fig. 4.—Position in which patient sleeps.

Results of the examination were practically negative. On account of the rigidity and movements examination of both deep and superficial reflexes was very unsatisfactory, but apparently they were normal. The cornea were normal and percussion indicated normal liver dulness. At this time the diagnosis seemed to be easy.

In this connection I might mention a very similar case seen with Dr. Schott in September, 1913. That boy also was 7 years old, and the trouble began in the right leg, which he constantly carried flexed at the knee and hip. This contracture showed the inconstancy and inconsistency which so frequently in these cases has led to a diagnosis of hysteria. The boy could not voluntarily extend hip or knee, and there was resistance to passive extension. He walked with what might be called a typical hysterical gait. With knee and hip flexed but foot extended, he rather slowly advanced the right foot until the tip of the toe touched the floor and then hopped forward with the left leg. When I asked him to turn a childish somersault he readily did so, and in the act the hip and knee straightened out in a perfectly normal way. I made a diagnosis of hysteria, but later had an opportunity to reverse my decision. I showed the boy at the meeting of the American Medical Association in Detroit, when there could be no doubt that the case was one of dystonia musculorum.

In his recent monograph Hall (book review in this issue of the ARCHIVES OF NEUROLOGY AND PSYCHIATRY) classes this disease with progressive lenticular degeneration (Wilson) and pseudosclerosis (Strümpell) and would designate the group "hepato-lenticular degeneration." There have been only two recorded necropsies in dystonia musculorum, and as neither case was a quite typical one, the pathology may still be considered as not definitely settled.

The condition of this boy has been considerably alleviated by relatively large doses of hyoscin (1/100 grain three times a day), which he tolerates exceedingly well.

DISCUSSION

DR. FRANK SMITHIES: When I saw the boy in the summer of 1918 I thought his case was exceedingly interesting and unusual. Our notes indicate a diagnosis of tumor at the base of the brain, passing back toward the medulla. The gait was shuffling and erect station was maintained with difficulty. He could not stand on one foot. After walking 30 or 40 feet (9.12 or 12.16 meters) he stooped forward, pressing his hands on his thighs. In getting up from the recumbent position he progressed fairly well to the sitting posture and fairly well to his feet, but to become erect he climbed with his hands on his thighs, particularly on the right side. The Wassermann reaction was negative on the patient and his mother; the father was not tested. The fundi of both eyes were definitely engorged and edematous. Roentgenographic examination showed an enlarged thymus. There were no signs of pressure; the spine was normal; the hip joint surface was thickened, especially on the left. There was definite irregularity and some erosion of the head of the femur. The skull laterally showed a very small sella and an anomalous basal skull contour. We thought this was indicative of some anomaly at the base of the brain. I saw him in consultation with another physician and made the diagnosis of tumor, largely from the physical findings, the roentgenogram and because his twin brother had had a glioma.

DR. LEWIS J. POLLOCK: I saw this boy about a year and a half ago, and the hyperkinesia was then very slight. One striking feature was exaggeration of the position described by Dr. Smithies, namely, the inability to assume an erect position from the prone except by assistance of the arms as seen in progressive muscular dystrophy—which condition I thought it was. It is exceedingly interesting to note the type of spasm which occurs in these cases. They are more or less homologous to those of torticollis. I recall one case which began as a torticollis. The movements then spread to the rest of the body, and those of the head became so marked that the patient rubbed off all the hair on the back of her head.

Strikingly suggestive of the pathogenesis of such disorders is a case which I saw of a hemiathetosis following a hemiplegia as the result of a thrombosis, which occurred in a woman 39 years old. Accompanying the typical unilateral athetosis was a marked torsion spasm of the opposite sternocleidomastoid. I believe this was due to a lesion in the lenticular nucleus.

DR. DAVID M. LEVY: We made a test which might be of interest because the boy was examined by the Child Study Department. He did not get beyond the first grade in school. In the other cases reported in the literature a notation is made of no intelligence defect, although in the cases reported by Wimmer he recites a number of mental disturbances. This boy rates 8 years by the Stanford Binet test, which should enable him to do third grade work, but he does not get beyond the first grade. He is classified by the test in the subnormal group, not feebleminded. Another interesting thing the mother told me was that the psychologist who examined the boy made quite a good deal of the fact that he would not dress himself. Not knowing anything about the pathology of the physical disability, he thought the whole thing was to be attributed to his being mentally defective.

A CASE SHOWING FACIAL DIPLEGIA. DR. JOHN FAVILL.

A laborer, aged 41, entered Cook County Hospital, Dec. 31, 1921. His family and his past history were unimportant. There had been no recent use of alcohol, no diphtheria and no gastro-intestinal or other evidence of poisoning.

The present illness probably dated from about the middle of October, 1921, at which time he had a chancre. He stated that a blood Wassermann reaction was positive and that he received nine injections of silver arsphenamin at the Central Free Dispensary. The lesion healed after the third injection. No secondary infections have appeared. About the middle of December, after three days' work shingling a house in very cold weather, he noticed pain in the left side of his face. Earache, tinnitus and gradual loss of hearing set in on the right. In about a week—just a week before entering the hospital—he noticed the facial paralysis. He could not expectorate or close his eyes. Both sides were apparently affected at the same time. The earache was relieved by hot applications, and no discharge occurred. There was some dizziness when walking but no sense of whirling when lying down. He did not vomit and could sleep well.

General examination revealed nothing important. The blood pressure was: systolic 150; diastolic 110. Temperature, pulse, respiration and urine were normal.

The gait was slightly ataxic, coordination fair. No paralyses other than the facial were noted. All reflexes were present and normal, with the exception of rather lively but equal knee reflexes. Sensation was normal for pain, touch, temperature and deep sensibility.

Cranial Nerves: The first nerve was normal. There was diminished vision on the left as the result of an old corneal scar. The left pupil was slightly irregular. Both eyes reacted normally to light, consensual and accommodation tests. The fundi were normal. There was mixed astigmatism. The third, fourth and sixth nerves were normal. The fifth nerve, sensory division, was normal, but the motor division showed weakness of the left temporal and masseter. They responded, however, to the faradic current. The left pterygoids were weak, the jaw deviating somewhat to the left on opening. The jaw reflex was present. The seventh nerve showed complete paralysis of muscles of expression. We could obtain no response in the upper group from the faradic or galvanic current. Stimulation of nerves and muscles in the lower group by the faradic current gave no response, but the galvanic current caused a slow contraction. On the right the cathodal closure contraction equaled the anodal closure contraction, but on the left the anodal closure contraction exceeded the cathodal closure contraction. Taste was certainly impaired if not quite lost in the anterior and middle thirds of the tongue on both sides. The patient said there was dryness in the left half of the mouth. The eighth (cochlear) nerve showed marked deafness on the right, moderate on the left. The canals, membranes and mastoids were normal. Weber's test showed lateralization to the left. The Rinné test was negative on both sides. The Schwabach test showed shortening. Galton's test on the right was 15,000 to

1,024, on the left 18,000 to 32. The eighth (vestibular) nerve showed no spontaneous nystagmus or past pointing. The results of horizontal canal tests were: Right turning gave nystagmus to the left 18 seconds but no past pointing; left turning gave no nystagmus or past pointing. Caloric tests had no effect on either side. The ninth, tenth and eleventh nerves were normal. The twelfth showed slight weakness on the left. The tongue protruded slightly to the left but could be moved in all directions. It showed no atrophy.

Laboratory Findings: The Wassermann reaction was positive on both the blood and spinal fluid. The colloidal gold reaction was 5 5 5 5 4 3 1 0 0 0.

For the past two weeks the patient has been treated with mercury, arsenic, potassium iodid and one injection of neo-arsphenamin. There has been no apparent improvement.

The etiologic diagnosis is somewhat obscure. If we consider this a bilateral Bell's palsy from, say, exposure to cold, it would explain the facial paralysis, the impairment of taste, and the eighth nerve weakness, but we would not expect an involvement of the left fifth or twelfth nerve. If we consider a syphilitic basilar lesion, it would explain all the positive findings, including taste impairment, providing we assume that at least a part of taste is transmitted along the nervus intermedius from the geniculate ganglion to the brain stem. It is strange, however, if this is of syphilitic etiology, that there have been no headaches, no sixth nerve trouble, no optic disk changes and no improvement from treatment.

DISCUSSION

Dr. Hugh T. Patrick: Some years ago I reported a facial diplegia as the principal indication of multiple neuritis following slight infection and at that time found that probably bilateral Bell's palsy is of the same nature. That is, it is degenerative, not really inflammatory, and due to an infection, assuming exclusion of syphilis, tumor, etc. Dr. Favill's case seems to be one of these—with a little added.

I would suggest that Dr. Favill reexamine the superior seventh nerve with the galvanic current. There should be contraction with direct stimulation of the muscle. It is impossible that galvanic irritability could disappear in seven or eight weeks.

The loss of taste in the anterior half of the tongue practically settles the localization, because there is only one part of the nerve accompanied by the chorda tympani. Wherever else the lesion may be, it must involve the part of the nerve in the petrous portion of the temporal bone.

Dr. A. B. Yudelson: Was there any disturbance of deglutition?

Dr. George W. Hall: I had occasion some time ago to read an article by Carl von Rad (A Case of Facial Diplegia with Ophthalmoplegia Externa. Deutsch. Ztschr. f. Nervenh. **17**:209) on involvement of the cranial nerves of infectious origin without involvement of the other peripheral nerves. He reported one case in a boy of 15 years with facial diplegia coming on suddenly with almost simultaneous involvement of the third, fourth and sixth nerves on that side, producing extreme ophthalmoplegia. The condition cleared up entirely within four and a half months. He quotes many other cases involving the fifth nerve, which were put on the basis of being peripheral nerve involvement and not nuclear involvement.

Dr. H. Douglas Singer: I should like to ask the degree of intensity of the Wassermann reaction in the spinal fluid and whether sufficient blood was present to account for this reaction. Is it not possible that the two conditions can be combined; that is to say, that there is a multiple neuritis of syphilitic origin, a toxic degeneration of the nerves due to syphilis?.

Dr. Favill (closing the discussion): There was no disturbance in deglutition at any time. The patient says that for a long time he has preferred to chew on the right side, which may denote a long standing weakness in the left fifth nerve, or the muscles which it supplies.

My suggestion of a basilar lesion accounting for the taste impairment was made in the belief that some taste is transmitted by the nervus intermedius, which with the seventh and eighth nerves could be caught central to the internal auditory meatus. I do not know whether it is differentiated which form of taste goes this way and which the other. However, even if all taste fibers from the anterior tongue leave the facial canal from the geniculate ganglion, along the great superficial petrosal, to join the middle sensory branch of the fifth nerve, they still have to cross the base of the brain to get into the brain stem and, I should think, might be affected then.

The determination of the degree of the Wassermann reaction is usually not given in the county hospital laboratory reports, and I cannot state what the number of "plus" was. The record stated that microscopic blood was present. There were about four red cells to the field, which probably would not produce that result.

MULTIPLE SOFTENING VERSUS MULTIPLE SCLEROSIS. G. B. Hassin and Peter Bassoe.

(To appear as an original communication in the Archives of Neurology and Psychiatry.)

Book Review

LA DEGENERESCENCE HEPATO-LENTICULAIRE. MALADIE DE WILSON — PSEUDO-SCLEROSE. Par H. C. Hall, Ancien Chef de clinique á l' "Hospital de Bispebjaerg," Copenhague, Chef de laboratoire de l'Institut Sérothérapique de l'Etat Danois. Preface du Prof. Pierre Marie. Price, 20 francs Pp. 360. Paris, 1921.

This brochure, a translation from the Danish, is the most extended review of Wilson's disease, pseudosclerosis and cognate maladies which has appeared, being much more detailed than the monograph of Stertz (Archives Neurology and Psychiatry **6**:357 [Sept.] 1921), which, by the way, receives no notice from Hall.

In the first two chapters, forty-four pages, the author gives a sketch of progressive lenticular degeneration as a morbid entity and outlines the development of our knowledge of this disease and of pseudosclerosis and of the gradual tendency to correlate the two as closely related, if not identical, diseases.

Chapter 3, seventy-three pages, relates the exceptional personal experience of the author. He had carefully examined four patients and reports three additional cases reported to him by others. One of his own cases is clinically reported in full; it then came to necropsy which was complete, including detailed microscopic study of the central nervous system, abdominal and thoracic organs and the cornea. Characteristic lesions were found in the brain, liver and cornea. His patients showed the familial tendency of the disease. This chapter is illustrated by excellent photomicrographs and photographs.

The author then tabulates (Chapter 4, twenty-four pages) sixty-eight cases of Wilson's disease and pseudosclerosis reported since 1912, including his own.

Symptomatology is methodically covered (sixty pages) and pathologic anatomy fully detailed (fifty-four pages), including an exhaustive study of the corneal pigment found in many of these cases. The author then groups progressive lenticular degeneration (Wilson's disease), pseudosclerosis (Westphal-Strümpell) and dystonia musculorum deformans (Oppenheim) or the torsion spasm of Ziehen as three types of one disease, which he proposes to designate hepatolenticular degeneration.

In Chapter 9 the author considers various striate syndromes, six in number: Wilson's disease (with pseudosclerosis and torsion spasm), Huntington's chorea, double athetosis, paralysis agitans, juvenile paralysis agitans, and vascular, syphilitic and neoplastic lesions in the striatum.

Chapter 10 is devoted to pathologic physiology, Chapter 11 to differential diagnosis and Chapter 12 to etiology. Seven pages of conclusions terminate the book proper, but this is followed by an appendix noting some recent publications and an extensive bibliography. The monograph as a whole is an excellent piece of work, may well guide subsequent workers, and will save any one investigating the subject an enormous amount of bibliographic research.

Perhaps it is pertinent to add that while Pierre Marie contributes a frankly laudatory preface, he quite as frankly avows reservation as to the preponderant rôle played by the corpus striatum in the morbid groups described in this brochure. He doubts that the researches of Hall and others have determined the functions of the striate body and the character of symptoms resulting from lesions of this body. One of the chief reasons for these doubts rests in the symptomatology of what he and his pupils, Catola and Ferrand, have described as "cerebral lacunae of disintegration." In this *état lacunaire* the lenticular nuclei especially are often the seat of obvious multiple lesions, and yet the clinical picture is widely different from that of this so-called striatum group.

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GENERAL SYMPTOMATOLOGY AND DIFFERENTIAL DIAGNOSIS OF DISSEMINATED SCLEROSIS *

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IN ASSOCIATION WITH
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There is need for careful study of multiple sclerosis in all its aspects, clinical and pathologic. Above all, we must agree on its clinical limitations. If we succeed in establishing a definite concept of disseminated sclerosis, we shall help to clarify a number of other diseases of the central nervous system and their relation to the disease we are discussing.

Hitherto, there has been a wide divergence of opinion. Some have thought the disease rare; others that it is nearly as frequent as tabes. In this country the disease was at one time thought to be infrequent. In Japan, it is said to be practically unknown. On the other hand, Marburg[1] claimed that next to syphilis it is the most common organic disease of the nervous system, and Stieffler[2] has laid especial emphasis on the frequent occurrence of multiple sclerosis among German soldiers during the war. One group of authors has claimed that it is postinfectious—possibly a form of encephalomyelitis (Marie[3]). Others have contended that it is more often endogenous and degenerative (Strümpell and Müller[4]) or that it is endogenous and toxic (Oppenheim).[5]

Some of us were firmly convinced that multiple sclerosis is one of the few positively nonsyphilitic diseases of the central nervous system;

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* Read at the Meeting of the Association for Research in Nervous and Mental Diseases, Dec. 28, 1921.

* From the Neurological Service of Mount Sinai Hospital.

1. Marburg: Handbuch der Neurologie, Special Neurology 1, **2**:911, 1911.

2. Stieffler: Ztschr. f. d. ges. Neurol. u. Psychiat. **90**:174, 1920.

3. Marie: Sclerose en plaques et maladies infectieuses, Progrès méd. **12**: 287-289, 305-307, 349-351, 365-366, 1884.

4. Strümpell and Müller: Einige Bemerkungen zur Aetiologie der multiplen Sclerose, Neurol. Centralbl. **115**:146-161, 1918.

5. A history of trauma was noted in only fourteen of our cases.

while others, including Spiller,[6] believed that syphilis may be an important factor in the causation of the disease.

Kuhn and Steiner[7] thought they had demonstrated the spirochetal origin of multiple sclerosis, and although this has been disproved by Rothfeld, Freund and Hornowski,[8] and has also been denied by Birley and Dudgeon,[9] the syphilitic origin of the disease has received some support from Schuster,[10] Gye,[11] Marinesco[12] and Siemerling.[13]

To my great surprise, I (Sachs) heard Pierre Marie say in Paris last summer that all cases of multiple sclerosis in patients above the age of 30 years were syphilitic in origin. Are he and we considering the same clinical entity?

Many observers in this country and Europe, more particularly in France, will not make the diagnosis of multiple sclerosis unless the classical triad of symptoms—nystagmus, intention tremor and scanning speech—is present; while others, like ourselves, venture to diagnose the disease in the presence of another series of symptoms, although one or two of the famous triad developed and emphasized by Charcot[14] and his followers, may be absent. As in tabes dorsalis, the earlier concepts of multiple sclerosis were based on the full fledged chronic forms of the disease, and as such the older clinical studies were keen and discriminating. The present day views, at least those which we hope to prove acceptable, are based on the attempt to recognize the disease in its earliest stages.

It is quite in order here to refer briefly to the fact that the older studies in the pathology of the disease differ from those of the present day, because the findings as reported years ago were concerned entirely with the later, and often with the terminal, stages of the morbid process; whereas at the present time we are more interested in the beginning of the disease process. The older writers were concerned with the histology of the plaques, while the more recent group of investigators has attempted to determine the process leading to the development of sclerotic patches.

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[6] Spiller: The Subacute Form of Multiple Sclerosis, Arch. Neurol. & Psychiat. **1**:219-230 (Feb.) 1919.

[7] Kuhn and Steiner: Ueber die Ursache der multiplen Sklerose, Med. Klin. **13**:1007, 1917; Ztschr. f. Hyg. u. Infectionskrankh. **90**:417-422, 1920.

[8] Rothfeld, Freund and Hornowski: Experimentelle Untersuchungen über die pathogenese der multiplen Sklerose, Deutsch. Ztschr. f. Nervenh. **67**:257, 1921.

[9] Birley and Dudgeon: A Clinical and Experimental Contribution to the Pathogenesis of Disseminated Sclerosis, Brain **44**:150-212, 1921.

[10] Schuster, J.: Beitrag zur Kenntnis der multiplen Sklerose, Ztschr. f. d. ges. Neurol. u. Psychiat. **65**:1, 1921.

[11] Gye: The Experimental Study of Disseminated Sclerosis, Brain **44**: 213-222, 1921.

[12] Marinesco: Etude sur l'origine et la nature de la sclerose en plaques, Rev. neurol. **26**:481-488, 1919.

[13] Siemerling: Spirochäten im Gehirn eines Falles von multipler Sklerose, Berl. klin. Wchnschr. **55**:273-274, 1918.

[14] Charcot: Lectures on Diseases of the Nervous System, Series 2, London, 1881.

In view of the discrepancies just cited, it will be well to make a fresh start in the clinical study of the disease, neglecting for a moment the studies of Charcot, Marie, Oppenheim,[15] Strümpell, Müller, Taylor,[16] Spiller and Jelliffe,[17] and wholly disregarding a critical digest of the disease which Sachs [18] published in 1898, except to say that many of the problems confronting us today were recognized and stated by the writers of several decades ago.

FREQUENCY OF DISSEMINATED SCLEROSIS

Our own studies are based on a series of 141 cases. Ninety-one cases were observed in the neurologic service at Mount Sinai Hospital during a period of ten years, from 1912 to 1921 inclusive, and fifty cases at the Montefiore Hospital for Chronic Diseases. Figures demand interpretation. The Mount Sinai service is essentially an "acute" service. The hospital stay of any patient is supposed to be limited to a period of six weeks.

TABLE 1.—Total Admissions to the Neurological Service, Two Thousand Three Hundred and Fifty-Seven Patients

Disease		Cases	
Multiple sclerosis		91	(3.9%)
Syphilitic affections of the central nervous system		562	(23.8%)
Of these:			
Cerebrospinal syphilis	317		
Tabes dorsalis	160		
General paresis	85		

During this entire period we did not encourage the admission of patients suffering from multiple sclerosis. We did encourage the admission of patients with syphilitic affections, and yet our records show that multiple sclerosis was more than half as common as was tabes dorsalis and fully as frequent as general paresis—the last, like multiple sclerosis, being observed as a rule in its earliest stages. In this group the incidence of the disease is understated, a very large proportion of patients with multiple sclerosis not requiring hospital treatment.

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[15] Oppenheim: Zur lehre von der multiplen Sklerose, Berl. klin. Wchnschr. **33**:184-189, 1896.

[16] Taylor: Multiple Sclerosis: A Contribution to Its Clinical Course and Pathological Anatomy, J. Nerv. & Ment. Dis. **33**:361-406, 1906.

[17] Jelliffe: Multiple Sclerosis. Its Occurrence and Etiology, J. Nerv. & Ment. Dis. **31**:446-455, 1904.

[18] Sachs, B.: On Multiple Sclerosis with Special Reference to Its Clinical Symptoms, Its Etiology and Pathology, J. Nerv. & Ment. Dis. **25**:314-331, 464-478, 1898.

The smaller group of the Montefiore Hospital is classified in Table 2.

TABLE 2.—Admissions to the Montefiore Hospital

Disease	Cases
Multiple sclerosis	50
Syphilitic affections of the central nervous system	167
Of these:	
Cerebrospinal syphilis	65
Tabes dorsalis	85
General paresis	17

In this institution for chronic diseases, in which there was no reason to give preference to any special group, the proportion of disseminated sclerosis to tabes is as 5 to 8.5.

We note that of the 141 patients, 100 were between the ages of 20 and 40 years.[19]

SIGNS AND SYMPTOMS OF THE DISEASE

In the study of the signs and symptoms of disseminated sclerosis, I (Sachs) was most anxious to avoid the dangers that lurk in statistics. For that reason I constructed from my own clinical experience and impressions Table 3. The percentages were added later as the result of Dr. Friedman's careful analysis of the hospital records. May I add at once that the diagnostic importance of a symptom is not always to be measured by the frequency of its occurrence? For instance, unusual remissions, or disturbances of vesical control, may be noted more frequently than pallor of optic disks, and yet the diagnostic importance of the latter is far greater than that of the former.

Without wishing to encroach on the topics assigned to others, let us dwell briefly on a few of the more important signs and symptoms. Let us also assume that the majority of the facts here adduced are known to, and conceded by, all.

First, it is of special interest to note the gradual development of the weakness, as a rule in the lower extremities, in association with increase of the deep reflexes.[20] The upper extremities are less frequently involved in the general loss of power, while a slight ataxic tremor[21] often precedes by months the development of weakness or paralysis of the upper extremities, and the upper extremity reflexes are increased at an early day. In both the upper and lower extremities weakness or paralysis is associated with a moderate degree of spasticity; not infrequently there is also in the early stages of the disease a slight though distinct disturbance of sensation.[22]

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[19] Second decade eight cases, third decade forty-seven cases, fourth decade fifty-three cases, fifth decade twenty-five cases, and sixth decade five cases. These figures do not accurately account for the age of onset.

[20] In 115 cases the chief complaint was weakness and stiffness of one or both lower extremities.

[21] Cerebellar ataxia and adiadokokinesis were noted in sixty-six cases, showing the frequent involvement of cerebellar pathways.

TABLE 3.—Signs and Symptoms of Multiple Sclerosis in the Order of Their Diagnostic Importance. Based on the Study of One Hundred and Forty-One Cases

	Percentage
1. Easy fatigue, weakness and stiffness of one or both upper or lower extremities culminating in spastic paraplegia	81.7
Associated with	
Increase of deep reflexes	90
Positive Babinski sign	78.3
2. Nystagmus, generally horizontal, slight at the beginning, gradually becoming more marked	70
3. Ataxic tremor of upper extremities and tremor of the head	55.3
4. Marked diminution or loss of abdominal reflexes	83.7
5. Spastic ataxic or ataxic gait and station (including the Romberg symptom)	43.2
6. Scanning speech or some form of dysarthria	36
7. Pallor of optic disks, especially of the temporal halves	32.6
8. Disturbance in facial innervation, often slight	32.6
Deviation of tongue, 10%	
Disturbance of deglutition, 3.5%	
9. Explosive laughter and emotional instability	17
10. Unusual remissions often leading to disappearance of symptoms	42
11. Transitory ocular palsies with diplopia	29
12. Vague objective and subjective sensory disturbances:	
Objective: (1) Posterior column disturbance	17
(2) Pain, touch and temperature disturbance	16.3
Subjective: Numbness, tingling and pain	30
13. Disturbance in vesical (not rectal) reflexes	40
(Hasty or delayed micturition); incontinence in 21 cases, 14%)	
14. Tenderness of the spine, chiefly mid-dorsal	12
15. Dizziness (vestibular vertigo)	8¼
16. Mental changes	15.6
17. Auditory nerve involvement	2

IMPORTANT NEGATIVE SIGNS AND SYMPTOMS

1. Pupils generally active with occasional hippus.
2. Biologic tests negative except for the occasional presence of globulin and slight increase in the number of cells in the spinal fluid in a few instances.

The fact that the disease patches occur at various levels in the pyramidal tracts and in the cerebellar pathways accounts for the character of the motor symptoms and also for the easy division into special types in accordance with the topographic distribution of the lesions. If we choose, we may establish spinal, bulbar, cerebral, hemiplegic and cerebellar types.

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[22] Astereognosis was noted in five cases, possibly accounting for the "loose arm" referred to by various writers.

The disease process and the disease symptoms are widespread. Of the increase of the deep reflexes [23] little need be said, except that it is within moderate bounds, that it is generally equally and symmetrically distributed over the entire body, and that in many instances the jaw reflex is very active, as evidence that the sclerotic patches may be distributed throughout the length and breadth of the central nervous axis.

The diminution or loss of the abdominal reflexes is the one symptom of importance that has been added to the symptomatology of multiple sclerosis within the last twenty years. We have been forced to attach great significance to it, yet it is only fair to state that some French authors, like Marie and Sézary,[24] are inclined to disregard the value of this reflex.

In many instances the absence of the abdominal reflex has led us to suspect the presence of disseminated sclerosis early in the disease, the suspicion having been confirmed by subsequent developments. How can we account for the frequent loss of this reflex? Except at the beginning of the disease, all abdominal reflexes seem to be equally affected. I find no explanation except that in view of the extensive character of the disease, the reflex pathways with their cerebral connections are certain to be hit somewhere by one or more of the sclerotic patches; and this view is substantiated by Monrad-Krohn,[25] a Scandinavian writer, who in a recent and exhaustive monograph on the abdominal reflexes says that these reflexes are present in all healthy persons with normal abdominal walls, and that there is a pathway connecting the spinal arc with the sensorimotor cortex.

So far as the speech disturbances are concerned, scanning speech does not tell the whole story. In addition to or instead of syllabic utterances we may have other forms of dysarthria. Speech may be purely tremulous or bulbar or cerebellar in character.

Ever since Uhthoff's [26] day, the pallor of the temporal half of the optic disks [27] has had great diagnostic value, and, last but not least, the unusual remissions of the disease often afford great difficulty in diagnosis. Sometimes men of experience doubt the diagnosis because of the disappearance of many signs. The gait improves, the speech becomes less scanning, the contractures are partially relaxed, the ataxic tremor of the upper extremities may be far less pronounced. Great subjective improvement is reported by the patient, and the general progress is so marked that not infrequently hysteria or some functional form of disease[28] is suspected. The diagnosis of multiple sclerosis may safely be made if a number of the important symptoms enumerated in Table 3 are present, and if the disease runs a subacute or chronic course.[29]

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[23] Ankle clonus was present in sixty-one cases; patellar clonus in twenty-nine cases. The knee reflexes and the Achilles reflexes (tabic type), were diminished in three cases.

[24] Sézary: Traite de pathologie médicale et de therapeutique appliquée, Neurologie **1**:338.

[25] Monrad-Krohn: On Abdominal Reflexes, Norsk Mag. f. Lægevidensk. **79**:1918, supplement to December number (English summary).

[26] Uhthoff: Untersuchungen über die bei multipler Herdsklerose vorkommenden Augenstörungen, Arch. f. Psychiat. **21**:303-410, 1890.

[27] Expert ocular examination revealed "blurring of the disks or mild optic neuritis" in eleven cases. Vision was found "impaired" in twenty-five cases without objective disk findings.

DIFFERENTIAL DIAGNCSIS

The textbooks give a long list of diseases from which multiple sclerosis is to be differentiated. The list includes paralysis agitans, tumor and pseudotoumor of the brain (especially in the cerebellar pontile angle), and of the spinal cord, general paresis, hysteria and many other conditions. We may safely leave the consideration of these to the textbooks.

There is one differential diagnosis of paramount importance, and to that it will be well to give full consideration. Is the patient suffering from multiple sclerosis or from multiple cerebrospinal syphilis? In both diseases the patients have in the course of a few months or possibly a few years developed from slight beginnings a more or less marked spastic weakness of the lower extremities associated with increase of all the deep reflexes. In both diseases there are marked periods of remission and of exacerbation. Personally, I have seen the remissions just as marked in the one disease as in the other.

In cerebrospinal syphilis there are pupillary symptoms and ocular palsies that point indubitably to the constitutional infection, and there are in the majority of instances positive biologic findings: a positive Wassermann reaction in the blood and in the spinal fluid with increase in globulin and in the number of cells. In disseminated sclerosis we have pronounced nystagmus, transitory ocular pareses, more or less marked intention tremor, as well as spastic contracture of the limbs. To be sure, there are also cases of cerebrospinal syphilis in which nystagmus occurs and in which there may be slight ataxia or ataxic tremor of the upper extremities. If there is distinct syllabic or scanning speech the diagnosis of disseminated sclerosis is obvious.

But the difficulty is that there are also some cases of cerebrospinal syphilis in which there may be a more or less marked dysarthria, bulbar

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28. We have noted distinct mental changes in only twenty-two patients, exclusive of those with emotional instability and explosive laughter. A childish attitude toward their illness and a certain degree of euphoria have been noted.

29. Marburg's substitute triad, afebrile course, multiplicity of foci and unusual remissions, is not sufficiently definite for diagnostic purposes.

or cerebellar in type. The two groups approach each other so closely that in not a few instances it is well nigh impossible to state definitely from which one of the two diseases the patient is suffering; but there are a few differential signs of great importance.

First and foremost, in disseminated sclerosis the pupillary reactions are almost universally normal, whereas in fully 90 per cent. of cases of cerebrospinal syphilis immobility of the pupils is an early and constant symptom. If there is an irregular contour of the pupils as well, the suspicion of a syphilitic disease is fully corroborated. The ocular palsies in syphilis are early and complete—in multiple sclerosis they are partial and transitory. In disseminated sclerosis the serologic findings are practically negative; in cerebrospinal syphilis they are, as a rule, positive enough to confirm the diagnosis.

There is one other condition of great significance. The spasticity in cerebrospinal syphilis is greater than in disseminated sclerosis unless the patients are in or near the terminal stage of the disease. In the early stages of disseminated sclerosis there is weakness and only a slight degree of spasticity. In cerebrospinal syphilis there is marked spasticity and relatively less weakness. As Erb pointed out years ago, the rigidity of the patient with spinal syphilis is excessive. He could go about easily if there were not inordinate spasticity of gait. The average patient suffering from multiple sclerosis has in the first years of his illness a weakness which becomes more and more pronounced, but spasticity is far less marked than paresis. Even so, there are further difficulties. May not disseminated sclerosis occur in a person suffering from constitutional syphilis who may, therefore, present immobile pupils and slightly positive serologic findings? But if he has a number of the other important symptoms of disseminated sclerosis, are we not justified in diagnosing multiple sclerosis in a person suffering from constitutional syphilis rather than cerebrospinal syphilis pure and simple? Furthermore, if the serologic findings are negative [30] and the pupils are not completely immobile, the diagnosis of cerebrospinal syphilis is doubtful, although the majority of symptoms point to syphilitic affection rather than to disseminated sclerosis.

These differences are emphasized by the fact that excessive spasticity or spasticity far greater than the paresis argues in favor of the syphilitic infection. Immobility of pupils and positive biologic findings help to corroborate this diagnosis. Slight spasticity, normal pupillary reactions, negative findings and the presence of other positive signs, will lead to the diagnosis of disseminated sclerosis.

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[30] The spinal fluid was negative in 114 of 122 cases studied. The spinal fluid Wassermann test was negative in all these cases. In eight cases the cell count was above normal, the figures being 12, 13, 16, 16, 20, 30, 30 and 40 cells, respectively. In three cases the globulin was increased.

ILLUSTRATIVE CASES

To illustrate the difficulties of the diagnosis, the symptoms in two cases will be presented briefly. The first is taken from private practice, but has not been included in our list, as we have excluded all private cases because in the nature of things they cannot be studied as thoroughly as are the hospital cases.

A man, now 39 years of age, has been under observation for two years and three months. At first he complained chiefly of a feeling of weakness in the knees and right foot when walking. He had been married for sixteen years and had four healthy children. A papilloma of the left vocal cord had been removed eight months before his first visit. He had a chronic nasopharyngitis. Lumbar puncture had been performed and the findings had been negative. The Wassermann test of the blood and of the spinal fluid was negative. He had a slightly spastic gait; all the deep reflexes were exaggerated. There was a slight suspicion of speech disturbance, although the patient himself asserted that his speech was normal.

At first there was distinct improvement under treatment with cacodylate injections. There was no intention tremor. He had perfect control over his vesical and rectal reflexes. His pupils reacted well; there was slight nystagmus. During the year 1920 the spasticity was much lessened, but beginning with the spring of 1921 there was a marked return of weakness of the legs and the spasticity had become extreme, so that now he has great difficulty in mounting stairs or in getting into an automobile. His pupils, however, are entirely normal; the Wassermann reaction of the blood remains negative; the abdominal reflexes are active; there is no marked disturbance of speech; there is little intention tremor and slight nystagmus.

We have been inclined, however, to regard this patient's condition as disseminated sclerosis, but the presence of the abdominal reflexes and the inordinate spasticity make it doubtful whether the case may not be one of cerebrospinal syphilis in spite of the normal pupils and the negative serologic findings. Were Pierre Marie to see this patient, he probably would feel justified in saying that he was suffering from cerebrospinal syphilis. There is some comfort in knowing that there are relatively few cases that present as marked difficulties as does this one.

In the second case the symptoms were briefly:

A clerk, aged 38, born in the United States, admitted Jan. 30, 1918, had a fall eleven years before his admission to the Home and since this accident he has been unable to get about. The records show: weakness and trembling of the legs, urgency of urination, marked exaggeration of all the deep reflexes, including a double Babinski sign; the abdominal reflexes were more feeble on the right; the cremasteric reflexes were absent; speech was hesitant; the patient had had a number of convulsions, the first seizure at the age of 22. It was stated that the head was tilted to the left; there was temporal pallor of the disks; the spinal fluid was normal; there was disturbance of sensation in the toes; the retina showed a picture of syphilitic degeneration; the right pupil was larger than the left and it reacted sluggishly; there was lateral nystagmus; weakness of the left side of the face; weakness of the right grip; loss of muscle sensation in the upper extremities; head tremor; ataxia, and tremor in both hands. There were also uncontrollable laughter, a double Babinski sign, and all the abdominal reflexes, except the upper left reflex, were absent. The Wassermann test was negative in the blood and in the spinal fluid.

Death was sudden. The postmortem examination revealed a primary idiopathic internal hydrocephalus, multiple sclerosis and pachymeningitis. There was thickening of the pia-arachnoid and marked enlargement of the ventricles. The ependyma was thickened; the spinal cord was markedly diminished in circumference and showed degeneration of the dorsal tracts and crossed pyramidal tract on the right side.

Clinically this patient presented the symptoms of multiple sclerosis with a suspicion of constitutional syphilis, and we would interpret the report of the pathologist in the same way—a combination of sclerotic plaques and a chronic syphilitic process.

COMMENT

In summarizing the clinal studies, let us again suggest that the diagnosis of disseminated sclerosis is warranted in the presence of a combination of any number of the important signs enumerated in Table 3, particularly if corroborated by the entirely negative character of the pupillary reactions and of the biologic tests.

That there will be occasional pitfalls and errors may be conceded, but that is practically as true of disseminated sclerosis as it is of all other organic diseases of the central nervous system.

MULTIPLE SCLEROSIS: THE LOCATION OF LESIONS WITH RESPECT TO SYMPTOMS *

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Assuming that multiple sclerosis, as ordinarily understood, represents a definite disease entity having a characteristic pathologic anatomy, a correlation of signs and symptoms with lesions should be possible as in other disorders of recognized organic character. Certain difficulties, however, at once present themselves; first, owing to the relatively nondestructive character of the pathologic process, no just parallel can be drawn between its apparent extent and the resultant signs and symptoms; in the second place, exact and painstaking correlations of lesions and symptoms have rarely been attempted in the now large number of clinically observed cases with subsequent necropsy. Most writers have been content with general statements regarding pathologic findings as explanatory of symptoms, as, for example, numerous cortical areas of sclerosis, or many sclerotic patches in the pons or oblongata or the cord showing plaques in both sensory and motor tracts. The reason for this apparent inaccuracy is sufficiently obvious. A disease process which manifests itself pathologically by perhaps a hundred or more lesions scattered indiscriminately throughout the central nervous system cannot adequately be described or pictured. Owing to the peculiarity of the pathologic alteration, also, even if its geography could be accurately mapped, the correspondence between lesion and symptom would still be so vague as to be of comparatively little physiologic value. In many cases there appears to be practically no relation between the symptoms observed during life and the findings postmortem. As the necropsies have multiplied it has become increasingly apparent that a very large number of cases unsuspected during life have been demonstrated to be multiple sclerosis of typical pathologic character. This fact alone doubtless accounts for what has always seemed to me an erroneous assumption that multiple sclerosis was a rare disease and less frequent in this country than in Europe. In view of our increasing knowledge the assumption that perhaps next to tabes, multiple sclerosis is the most frequent organic disease of the nervous system, may not be an over-statement.[1] The so-called formes frustes of Charcot are

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[1] Marburg agrees with Müller and Schultze regarding multiple sclerosis as the most frequent organic nervous disease except syphilis. Lewandowsky: Handbuch der Neurologie **2**:916.

certainly far more frequent than the classical type of the disease,[2] and presumably few would now agree with the statement made by Sachs[3] in 1898 that the diagnosis should not be made in the absence of the so-called cardinal symptoms.

In the analysis which follows an attempt will be made to proceed from the more general correlations to the more specific localizations so far as that is possible. However divergent the symptoms may be from the picture first drawn by Charcot,[4] we still recognize a type form of the disease characterized by nystagmus, scanning speech and ataxic tremor of the intention type to which may be added weakness with spasticity. This well defined combination of signs occurs in no other condition in like degree. The nystagmus, volitional tremor and speech defect may be regarded as due in some measure, at least, to the peculiar character of the lesion as well as to its location. The early loss of myelin and persistence of axons and cells must be held at least in part responsible for these characteristically irregular movements. Charcot[5] definitely regarded this irregularity of movement as conditioned by an altered resistance to conduction in the sclerotic area. If the myelin may be considered as in some sense an insulating mechanism, as pointed out particularly by Porter E. Sargent,[6] a possible partial explanation of the incoordination is found. Erb, on the other hand, believed it due rather to the localization of the sclerotic patches than to any peculiarity of the pathologic process itself, a theory which has gained in acceptance as the general knowledge of localization has increased. Dawson,[7] for example, considers the hypothesis established that the incoordination results from interruption of, or disturbance in, the cerebello-rubro-thalamo-cortical pathway. As this pathway, because of its wide extent, is altogether likely to be involved in some part of its course, secondarily affecting the innervation of the corticospinal and spinoperipheral motor tracts, an explanation of the tremor both of arms and legs is established as well as of the speech mechanism.[8] The eye muscle involvement leading to nystagmus is likewise regarded as due to lesions about the ventricle, aqueduct, third nerve nucleus, Deiters' nucleus and doubtless higher levels as well. The tendency to spasticity with or without hypertonicity is naturally explained by an invasion of the pyramidal tracts somewhere in their long course. If such a theory be valid, it naturally presupposes lesions in these regions when the classical type of the disease appears. It follows, if such lesions do not occur, that the typical picture of the disease is lost in a wide range of symptoms due to lesions otherwise localized.

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[2] Classical type, Müller, 15 per cent.; Marburg, even less; Aschern, three cases out of twenty-five, 12 per cent.

[3] Sachs: J. Nerv. & Ment. Dis. **25:**325, 1898. At the meeting at which this paper was presented Dr. Sachs said that he had changed his opinion regarding the diagnostic criteria of the disease.

[4] Charcot: Lectures on Diseases of the Nervous System, English translation by Sigerson, New Sydenham Society, 1877. Although written nearly fifty years ago, this lecture still stands as perhaps the best description of the disease.

[5] Charcot: Lectures on Diseases of the Nervous System, p. 218: "The long persistence of the axis-cylinders, deprived of medullary sheathing in the midst of the foci of sclerosis, probably plays an important part here. The transmission of voluntary impulses would still proceed by means of the denuded axis-cylinders, but it would be carried on irregularly, in a broken or jerky manner, and would then produce the oscillations which disturb the execution of voluntary movements."

[6] Unpublished research.

[7] Dawson: Rev. Neurol. & Psychiat. **15:**146, 1917. For a detailed account of various theories see Müller: Die multiple Sklerose des Gehirns und Rückenmarks, Jena, 1904, p. 115.

The attempt to follow these so-called formes frustes[9] in all their ramifications is obviously impossible. Before even attempting to particularize, it should be understood that symptoms of the most varied sorts, many of them quite impossible of explanation, may occur which, as shown by postmortem findings, must in some way be attributed to sclerotic patches of the kind under consideration. It is also a well demonstrated fact that many lesions are discovered at necropsy which gave no recognized sign of their existence during life, notably in the brain stem involving the cranial nerve nuclei and fibers.

As before stated, it is futile to attempt an exact determination of symptoms from lesions, or of lesions from symptoms, as is possible in other organic disorders, in which nerve elements are completely destroyed. Admitting this important source of error, the general principles of localization apply in this as in other diseases. Considered first from the symptomatic standpoint, the original group of symptoms —nystagmus, scanning speech and intention tremor—find their explanation presumably in lesions of the thalamus and its cerebellar connections, although the peculiar character of the pathologic process (myelin degeneration) must still be given some consideration. This group of symptoms occurs in a relatively small percentage of the cases. The bewildering number of symptoms common to this and other organic and even functional diseases may in a general way be explained by the multiplicity and irregular distribution of the lesions.

Charcot explained the ataxia and pain by invasion of the dorsal tracts, muscular atrophy by destruction of ventral horn cells, spasticity by involvement of the lateral tracts, nystagmus and difficulty of speech by lesions in the pons and oblongata, etc. Such general statements are obviously unassailable. The difficulty arises in the more minute correlations.

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[8] Probst: Deutsch. Ztschr. f. Nervenh. **12**:446, 1898. Probst describes a case in which there was neither intention tremor nor nystagmus in spite of extensive lesions in the pons, quadrigeminal region and dorsal longitudinal bundle.

[9] Charcot: Des formes frustes de la sclérose en plaques. Clinique des maladies du systéme nerveux, Paris, 1892, p. 399.

Somewhat dogmatic deductions are given as follows by Dawson: Symptoms in his case began with a weakness of the legs, passing off, recurring, growing rapidly worse and terminating in a spastic paraplegia. "This is obviously the clinical manifestation of the dense areas of sclerosis which were found throughout the spinal cord." These from their histologic appearance apparently were the earliest manifestations of the disease. The same was true of lesions found in the sacral region which were regarded as responsible for the patient's sphincteric difficulties. The volitional tremor which next developed is associated with patches in the superior cerebellar peduncle, red nucleus and optic thalamus. The nystagmus, an early symptom, was "undoubtedly associated with the periventricular and periaqueductal sclerosis, only parts of the oculo-motor nerves being involved." Patches in the cervical region are assumed to cause sudden numbness in the left arm followed by rapid development of large areas in the pons involving the eighth nerve producing deafness, and in the facial nucleus producing a right facial paralysis. Later a patch involved the sixth nucleus leading to diplopia from external rectus paralysis. Soon patches involved the twelfth nerve and nucleus leading to protrusion of the tongue to one side with slight trouble with speech and swallowing; dimming of vision followed by total blindness the next morning "was obviously the result of the development of patches in the optic tracts and chiasm." Finally, it is assumed that the areas in the cord became more extensive, involving the lower motor neurons and resulting in muscular wasting and emaciation. This observation is of interest since Dawson has been able to determine the age of lesions by their microscopic appearance, but even so the extent of his assumption is hardly justified.

It may be said without fear of contradiction that the frequent, if not universal, mental disturbances are due in large measure to cortical lesions, that the relatively slight but practically constant sensory defects are due to lesions in the cerebrospinal sensory tracts, and that the conspicuous motor phenomena result from interference with the motor conduction paths. One is, however, by no means justified in assuming in any given case that the cortex alone is involved in the mental disorder, or that sensorimotor signs are dependent on lesions in any one portion of the afferent and efferent tracts. In the attempt to explain the frequency of certain symptoms Brouwer[10] has advanced an ingenious hypothesis from the biologic and developmental standpoint, which is worthy of serious consideration.

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[10] Brouwer: The Significance of Phylogenetic and Ontogenetic Studies for the Neuropathologist, J. Nerv. & Ment. Dis. **51**:113, 1920.

He believes that it may be possible to explain the chief symptoms of the disease through an appeal to evolutionary principles. The usual statement that the frequency of spastic conditions is due to an affection of the pyramidal tracts because these tracts are longer and therefore more exposed, he regards as unsatisfactory. He, furthermore, does not agree with the generally accepted idea that sensory fibers are more resistant than motor fibers, hence the slight disturbance of sensibility. He also asks how it can be that in spite of its variety of manifestation, a certain definite group of symptoms still dominates the clinical picture. To meet these various objections and to consider the symptoms from a unitary standpoint, he appeals to the phylogeny of the nervous system. Reference is made to the following clinical examples in the attempt to establish his contention:

A patient with merely a slight paresis of the left facial nerve was almost totally unable to speak. The brain stem was much involved in the sclerotic process, both the nuclei of the cranial nerves and their roots. Why, he asks, can such a patient not speak while showing practically no changes in the function of the cranial nerves in general? In a second instance he refers to loss of the abdominal reflexes. Why, again, is the nystagmus almost invariably horizontal? If due to foci in the oblongata, why are other cranial nerves not involved? In a case of practically complete transverse lesion of the thoracic cord the legs may be almost totally paralyzed, whereas the sensory disturbances are usually relatively slight. Finally, why is the temporal half of the optic disk paler than the nasal half when apparently the entire nerve at some part of its course is sclerotic? A reconciliation of these difficulties is attempted.

Presupposing, as Brouwer believes justified, that multiple sclerosis is due to an infective agent of some kind, it is a fair assumption that the older parts of the nervous system have greater resistance to such agents than the phylogenetic and ontogenetic younger parts which naturally represent the higher, more developed functions. Reverting to the previous examples, the function of speech is a late development, whereas the cranial nerve tracts are for the most part archaic. Hence, lesions apparently affecting this whole area, in common, involve speech in a maximum degree. Again, the abdominal reflex occurs only in primates, hence it likewise is a late phylogenetic development and is therefore lost early. The horizontal nystagmus is brought into relation with the fact that the side movement of the eyes in the horizontal plane is present only in higher mammals on account of the position of the eyes in front of the head. Here, again, the same principle applies. That the disturbances of motility are greater and more frequent than those of sensibility is due to the fact that the pyramidal tracts are young, both from the racial and individual standpoint.[11] The cerebrocerebellar tracts in the pons are conspicuously developed in the higher mammals and particularly in man; therefore there is a frequency of disturbed coordination, since these tracts, developed late, are often involved in the sclerotic process. Finally, the much discussed temporal pallor of the disk (symptom of Uhthoff) finds its explanation in the imperfect crossing of the optic fibers in the mammalia, including man. Phylogenetically, the temporal half of the disk is the younger; hence, according to the theory, it suffers more in the pathologic process than does the nasal side.[12] The well recognized mental changes are naturally explainable on the same basis.

From such arguments as this Brouwer adduces the general principle that the causative agent in the disease damages younger and later developed functions much more definitely and persistently than older and more primitive functions. It is reasonable to suppose that higher developed functions should first succumb to a partially destructive lesion, such as that of multiple sclerosis. Brouwer appears to have made out his case, that the "fundamental" symptomatology runs parallel with both the phylogenetic and ontogenetic development of the nervous system, in the sense that the so-called cardinal symptoms and certain others frequently encountered result from functional disturbance in the tracts later developed. The theory, however, is difficult of application in relation to the signs and symptoms which multiple sclerosis shows in common with other forms of organic and functional disease.

MULTIPLE SCLEROSIS FROM THE ANATOMIC STANDPOINT

Considered from the anatomic standpoint, the (1) cortex, centrum ovale, (2) basal ganglions, (3) cerebellum, (4) optic system, (5) brain stem and cranial nerves, and (6) cord, may with advantage be considered separately.

The Cortex.—Sclerotic areas in the cortex were slow of recognition. Their presence was definitely established in the early nineties, although even as far back as 1869, a sketch by Charcot,[13] pictures lesions in the cerebellar cortex but apparently not in the cerebral cortex. That very numerous plaques may occur throughout the cortex is no longer open to question. The relation of such alterations to the frequent mental changes in the disease may in general be accepted, although naturally it is quite impossible to associate definite symptoms of impairment with definite lesions. Raecke[14] discusses the mental changes as observed up to 1906 but with very general pathologic observations in only one case. A later monographic article by Siemerling and Raecke[15] on the basis of eight cases with necropsies makes very general reference to the psychic changes in reference to the lesions. For example, in one case (Case 8 of the series) during life there was euphoria passing over to increasing dementia with changes of mood and grandiose ideas. Postmortem lesions, larger and smaller, were found in the cerebral cortex and white matter, many of them microscopic, with general brain atrophy. No further correlation is attempted. In other cases characterized by euphoria, similar vague statements are made regarding numerous areas in the cortex, but without further definition. It is clear from these and many similar observations that no exact correlation is possible between symptoms and lesions affecting the cortex, and that the cortex may be extensively involved without corresponding mental disturbance. No more exact statement can at present be made than that the cortex is frequently involved in the sclerotic process and that mental symptoms usually of the type of a progressive but not extreme dementia[16] are somewhat characteristic. In this connection Müller warns against drawing the deduction that extreme mental disorder corresponds to the number and extent of cortical lesions.[17] Our knowledge of the relation of mental processes to brain structure is far too vague to permit any deductions of value, especially in the disease under consideration, with the complicating existence of lesions in other and diverse areas of the brain.

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[11] Late myelinization.

[12] Early degeneration of the maculopapillary bundle has also been assigned as a cause of the temporal pallor, but this in no way controverts Brouwer's theory. He, naturally, does not confine his deductions to multiple sclerosis.

[13] Bourneville and Guérard: De la sclérose en plaques disséminées, Paris, 1869. Valentiner associated mental changes with involvement of the "subtsance of the central hemispheres."

The association of multiple sclerosis with dementia paralytica is of interest. Hunt,[18] in 1903, reviewed seven cases of this type, giving the necropsy findings in six, and added a detailed report of a personal case in which he found extensive cortical changes, alteration of cells, increase of glia, effacement of normal cortical markings, thickening of the meninges and vascular changes, together with loss of association and tangential fibers. Clinically the case apparently does not demand a diagnosis of dementia paralytica. Multiple sclerotic lesions in various areas, including the cortex, were demonstrated. The patient's memory was defective, and there was extensive mental deterioration not incompatible with uncomplicated multiple sclerosis. That the two diseases may coexist is obvious; the differential diagnosis during life is often extremely difficult if not impossible. The recent suggestion of the relation of syphilis to multiple sclerosis is important in this connection.[19]

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[14] Raecke: Arch. f. Psychiat. **41**:482, 1906. Duge: Deutsch. Ztschr. f. Nervenh. **51**:459, 1914.

[15] Siemerling and Raecke: Arch. f. Psychiat. **53**:385, 1914. Bibliography 441 titles, 158 cuts.

[16] Seiffer: Arch. f. Psychiat. u. Nervenk. **40**:252, 1905, characterizes this disturbance as a "polysclerotic dementia," the peculiarities of which are euphoria and frequent and sudden change of mood, for long periods standing in no definite relation to the usually slight degree of dementia. Other more pronounced symptoms may occur running the gamut of the entire psychic symptomatology. In certain cases the association with dementia paralytica should be considered. The euphoria of multiple sclerosis may be brought into relation with frontal lobe lesions, but, so far as known, no demonstration of such a relationship exists.

[17] Müller: Die mutiple Sklerose des Gehirns und Ruckenmarks, Jena, 1904, p. 78.

[18] Hunt, J. R.: Am. J. Med. Sc. **126**:974, 1903.

An illuminating case investigated by Dr. Solomon C. Fuller,[20] which he has kindly allowed me to study, is in outline as follows:

A woman, aged 47, was admitted to the Westborough State Hospital on Sept. 1, 1914, where, after three months, she died. She had contracted syphilis early in life. In 1907 she began to have difficulty in walking; the family physician thought this was caused by locomotor ataxia. She was, however, able to do her work, but with decreasing effectiveness. She became somewhat depressed and talked of suicide. Her conduct and disposition changed. Formerly neat and amiable, she became irritable and careless of her personal appearance; her memory became impaired, and speech at times was irrational. Just prior to her admission she had had several periods of excitement accompanied by violence. She created scenes on the street by using violent and profane language and showed foolish extravagance in the expenditure of money. Although unable to walk without crutches ordinarily, under the influence of excitement she was able to run with little disturbance of gait. She developed frequent incontinence of bladder and rectum. A physical examination revealed, among others, the following facts: Sense of smell was unimpaired. She insisted that she could not see well, but she was able to read a little. Movements of the eyes were unimpaired except for slight lateral oscillations (nystagmus?). The pupils were unequal; they reacted sluggishly to light and in accommodation. The fifth nerve was uninvolved except for some tremor; there was no disturbance in the facial distribution. Hearing so far as tested was not impaired; taste was unaffected; no atrophy of the tongue was present. Speech was drawling; there was elision of syllables; test phrases were poorly executed. The knee reflexes were very active. The left more so than the right. There were bilateral crossed adductor response, a bilateral Babinski sign and loss of abdominal reflexes; elbow and wrist reflexes were elicited. The finger-to-nose test was poorly executed. The Romberg test was not attempted on account of the paralysis. There was loss of bladder and rectal control; it was difficult to determine whether this was due to mental deterioration or to a focal spinal lesion.

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[19] Spiller, W. G.: The Subacute Form of Multiple Sclerosis, Arch. Neurol. & Psychiat. **1**:219 (Feb.) 1919. There is also a carefully analyzed case of syphilis of the tabetic type, combined with symptoms of multiple sclerosis by Breitbach in Deutsch. Ztschr. f. Nervenh. **72**:1, 1921. Necropsy examination revealed sclerotic plaques largely confined to the dorsal tracts, together with pathologic evidence of a possibly checked syphilitic process.

[20] Fuller, Solomon C.: Anatomic Findings of General Paresis and Multiple Sclerosis in the Same Case, Boston Society of Psychiatry and Neurology, Arch. Neurol. & Psychiat. **5**:757 (June) 1921.

From the foregoing history and examination the diagnosis of dementia paralytica was entirely justified and was confirmed by the necropsy examination. The evidences of multiple sclerosis during life were extremely slight. The existence of nystagmoid movements, alterations in speech, increased reflex activity and absent abdominal reflexes might have led to a suspicion of multiple sclerosis, but these symptoms were so overshadowed by the obvious paralytic dementia that they naturally were ignored. The postmortem examination revealed extensive sclerotic patches in the optic chiasm, nerves and tracts, slight lesions in the oblongata, extensive ones, particularly in the spinal cord, together with systemic dorsal degeneration of the median tract in the cervical cord and of the pyramidal tracts in the lumbar cord. The combination, therefore, on the pathologic side, of dementia paralytica, as shown by characteristic cortical as well as spinal changes, and multiple sclerosis is not to be questioned. The important etiologic question as to whether both lesions might be due to a common cause cannot here be discussed. Spirochetes could not be demonstrated. In view of the fact that there were definite sclerotic lesions, particularly in the dorsal tracts of the cord in the cervical region involving entering nerve roots, the careful examination made by Dr. Fuller is of interest from the point of view of correlation: In the upper extremities light touch sense was lost; pricks deep enough to draw blood were frequently not noted. Responses to cold and warm test tubes were in the majority of instances incorrect, and the correct responses gave the impression of happy guesses. A similar situation existed on the upper thorax. Deep pressure both here and on the arms was sometimes painful. There was loss of position sense in the fingers of the right hand; it was not disturbed in the left hand or toes, presumably on account of the position of the lesions. It would appear from this observation that all forms of sensibility are affected in a sufficiently advanced sclerotic degeneration. Whether the various types may be lost at different periods is a matter possible, but difficult, of determination.[21]

Basal Ganglions.—No satisfactory correlation between the lesions of the basal ganglions and the symptoms can as yet be made. The connections of these nuclei with other portions of the brain are so complex and numerous that unless the lesions are sharply limited to the ganglions, deductions of value cannot be drawn. Since this, so far as known, does not occur or has not been described, inferences only are permissible. Apparently sclerotic lesions of the striatum do not lead to the symptoms now generally recognized as appertaining to this nucleus. The characteristic rigidities, tremors (for example, of the paralysis agitans type) and incoordinations due to lesions of this region of the brain are not conspicuous in the sclerotic syndrome. It is, however, not impossible that the ataxic tremor and alterations in tonicity may in part be due to involvement of the striatum or one of its divisions. The volitional type of motor disorder seen in Oppenheim's dystonia musculorum bears a certain distant resemblance to the gait disturbance which at times occurs in multiple sclerosis. This, however, is merely speculative, and, therefore, does not now concern us. Essentially the same may be said of the thalamus. The frequent occurrence of forced laughter and weeping, more frequent, but by no means peculiar to multiple sclerosis, finds perhaps, its best explanation in thalamic or subthalamic lesions, but obviously this location cannot be its sole cause.[22] In a recently observed patient still living so far as known, the first and for a considerable period only definite symptom was a marked unilateral astereognosis, leading to a preliminary diagnosis of brain tumor. Later typical signs of multiple sclerosis developed. The possibility of such a symptom being due to a thalamic lesion must be entertained. How far the thalamus, irrespective of its connections, may be responsible for the characteristic incoordination of multiple sclerosis must at present be left undecided so far as convincing pathologic evidence is concerned.

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[21] Breitbach: Footnote 19, second reference.

Cerebellum.—The question as to how far lesions in the cerebellum affect the symptomatology of the disease is likewise involved in somewhat hopeless confusion and again for the reason that, so far as I am aware, typical sclerotic patches limited to the cerebellum have not been described. It is a fair assumption that the cerebellum plays its part in the general disturbances of coordination, but nothing more than an assumption. If asynergia [23] is the outstanding clinical feature of cerebellar disease, we may see in the dysmetria, tremor on voluntary movement, nystagmus, speech defects, without marked alterations in sensibility, a possible correlation between cerebellar lesions and symptoms. We are, however, in no way justified in assuming that these disturbances as seen in multiple sclerosis are to be attributed only to the cerebellum and not to its connections with the brain stem and higher levels. There is danger here, as in any attempt at clear-cut localization in this disease, of overlooking various lesions in other parts of the brain in the interest of a particular area of degeneration. This is especially true in so involved an anatomic mechanism as that which underlies disturbances of motility.

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[22] An extreme degree of forced laughter, personally observed, occurred in a typical case of Parkinson's disease, doubtless a lesion of the striatum.

[23] Tilney: Neurol. Bull. **2**:289, 1919.

The Optic System.—We stand on slightly firmer ground in the attempt to correlate the clinical and pathologic manifestations of the disease in the optic nerves, optic tracts and their cerebral connections, in spite of the fact that fundus changes and lesions stand in no predictable relation to each other. The basis of our knowledge in this field was laid by Uhthoff [24] in 1889 by an analysis of 100 cases with six necropsies in which the optic apparatus was particularly studied. In only one of these, no alteration was found in the nerve. In general, he found what has since been amply confirmed, that with marked pathologic changes in the nerve, the fundus may remain normal; that only slight ophthalmoscopic paling may occur, when the entire nerve is involved immediately behind the bulb; that under similar conditions often the naked nerve fibers of the papilla and others are relatively well preserved, and that there is no atrophy of the internal ganglion cell layer. It appears further that the anatomic changes, leading to disturbance of vision and alteration of fibers are due essentially to changes in the optic nerve, whereas the muscular disorders and nystagmus are dependent on central lesions naturally involving other nerves. The whole subject has been reviewed in detail by Wilbrand and Saenger.[25] Gnauck, in 1884, found sharply defined atrophy of the temporal side of the papilla and macroscopically interstitial changes in the nerves localized directly behind the bulb. Uhthoff, in 1889, pointed out the distinction between the primary atrophy of the nerve as seen, for example, in tabes, and that observed in multiple sclerosis; he also recognized the fact that under certain conditions they are not to be distinguished. Optic neuritis (a true inflammation and not due to pressure) presumably occurs oftener in multiple sclerosis than is ordinarily recognized since, owing to the character of the pathologic process, atrophy supervenes more quickly than in other conditions. Simple optic neuritis occurs in a certain proportion of all cases, 5 per cent. in 100 cases—Uhthoff, once in seventy-one cases—Frank, 13 per cent. in cases observed by Kampherstein. The occurrence of choked disk is a matter of interest. A case reported by Rosenfeld, in which there was transient choking, showed extensive lesions in the chiasm and nerve. Rosenfeld is of the opinion that sclerotic plaques directly behind the papilla may cause a true choking of the disk (Stauungspapille) which may not be regarded as an expression of general intracranial pressure since a recurrence of severe brain symptoms does not primarily lead to a repetition of the choking.[26] In general, as in other symptoms of the disease, these changes in the eyegrounds are likely to be transient and to give place either to recovery or slight atrophy. A rapid subsidence of swelling, apart from operation or other means for relief of pressure, is characteristic of multiple sclerosis. Apparent total or partial atrophy of the optic nerves is a much more frequent finding than choking of the disk. According to Uhthoff, ten cases, 30 per cent., showed complete atrophy ophthalmoscopically, and in 37 per cent. there was more or less marked paling of the temporal half. This condition is to be attributed to lesions in the nerve in close proximity to the papilla, but even this cannot be regarded as constant. For example, Eichhorst reports multiple sclerosis with optic atrophy in a mother and child. In both cases the cord, and not the brain, was most involved in the sclerotic process in spite of various ocular palsies and nystagmus. Oppenheim reports a case in which sclerotic changes of microscopic character were found in optic nerves and chiasm without disturbance of function. Uhthoff describes a similar case. Wilbrand and Saenger found a large, clean-cut patch of sclerosis in an optic nerve, in which the vision and ophthalmoscopic appearance were both entirely normal. The general rule applies here as elsewhere that so long as axons remain intact, function is not seriously interfered with. The varied disturbances of vision (fifty-two of seventy-one cases in Frank's statistics), sudden loss, unilateral loss, disturbance of vision as a first sign of the disease, changes in the fields, color defects, have been described by various observers.[25] A correlation between these findings and the pathologic changes in as unsatisfactory here as elsewhere. Uhthoff [27] and Lübbers [28] conclude that macroscopically a shrinkage of the nerve with extensive atrophic changes and microscopically cell proliferation and proliferative changes in general, with preponderant degeneration of the myelin, constitute the essential alterations seen in multiple sclerosis. The failure of secondary degeneration [29] due to preservation of axons accounts for the disparity between ophthalmoscopic appearances and alterations of the optic nerves. A predilection of the degenerative process for the papillomacular bundle may account for the frequent pallor of the temporal side of the disk.[30]

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[24] Uhthoff: Untersuchungen über die bei der multiplen Herdsklerose vorkommenden Augenstörungen, Berlin, Hirschwald, 1889.

[25] Wilbrand and Saenger: Die Neurologie des Auges. **5**:389, 1913. The following statements are taken largely from this review.

[26] Of interest in connection with the theory that choked disk is always due to intracranial pressure (Cushing).

Brain Stem; Other Cranial Nerves.—The motor innervation of the eye (third, fourth and sixth nerves) is most variously affected and in the usual inconstant and erratic manner. Alterations in the size and reaction of the pupil, bilateral and unilateral, have been described in bewildering variety, and the Argyll Robertson pupil has been observed rarely—all without wholly adequate explanatory pathologic alterations. The same may be said of the external muscles. Spiller[31] describes a case in which an "almost complete ophthalmoplegia existed"; an area of sclerosis was found postmortem, involving the muscles of the third, fourth and sixth nerves and also the posterior longitudinal bundle. He observes, however, that the "cell bodies of the oculomotor nuclei are not very distinctly diseased." Personal cases reported in the following pages are of small assistance in clarifying the situation. In general, nothing is to be gained by a multiplication of case reports, even with detailed results of microscopic examinations, since, as repeatedly observed, no exact determination can be made of the destructiveness of the lesion by a macroscopic examination or even by a microscopic study without a very special technic. The matter is further complicated by the fact that presumably, according to Müller, who agrees with Charcot, Parinaud and Uhthoff, central rather than peripheral lesions are responsible for disturbance in ocular movements.

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[27] Uhthoff: Untersuchungen über die bei der multiplen Herdsklerose vorkommenden Augenstörungen, pp. 408 and 442.

[28] Inaugural dissertation, Marburg, 1897.

[29] Buss: Deutsch. Arch. f. klin. Med. **45**:555, 1889. Description of a case with secondary degeneration.

[30] Wilbrand and Saenger: Neurologie des Auges, pp. 449-452.

The crura, pons and oblongata are frequently and extensively invaded, but with relatively slight involvement of the cranial nerve innervation;[32] as for example, in a personally described case, the nuclei of all the nerves lay in sclerotic areas, with slight disorder of function (see Case 2). Oppenheim is quoted as saying that he has continually found plaques in relation to the fifth nerve, without disturbance in the sensibility of the face. On the other hand, a persistent trigeminal neuralgia was also related by him to a sclerotic patch in the nerve root.[33] Müller has never observed difficulty in mastication. The facial and hypoglossal nerves may be slightly involved; the vagus and glossopharyngeal are rarely involved. A satisfying correlation is rendered impossible here, as in the ocular innervation by the possible involvement of higher levels, cortex or conduction paths. For example, the occasionally described weakness of the facial nerves is often of the cerebral type (Müller). The nerves of special sense, other than the optic nerve, in spite of lesions involving their origins or course, are seldom affected except in minor degree.[34]

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[31] Spiller, W. G.: Report of Two Cases of Multiple Sclerosis with Necropsy, Am. J. Med. Sc. vol. 125 (January) 1903.

[32] Burr and McCarthy: J. Nerv. & Ment. Dis. **27**:634, 1900.

[33] Nonne mentions instances of lancinating pain due to sclerotic degeneration of dorsal roots.

[34] These statements are general in character. Many individual cases have been described demonstrating a somewhat definite relationship between lesion and symptom, and in many instances the various cranial nerves have been markedly involved in their function, for example, pontile and bulbar types (Oppenheim, Cassirer, Marburg and others).

Cord.—Owing to the small transverse area and the length of the cord, the plaques of sclerosis almost inevitably invade all the tracts as well as the ventral horns, at some level. It is not surprising, therefore, that the greatest possible multiplicity of spinal symptoms should result. Ataxia, sensory disturbance of various sorts, sphincter disorder, sex difficulties, gait disturbance, tremor, muscular weakness, hypotonicity and hypertonicity, reflex alterations, occasional muscular atrophy and in less degree vasomotor defects may occur in various combinations. To attempt a detailed correlation of these signs and symptoms with the lesions observed postmortem would lead to no profitable result. Suffice it to say that when the sclerosis is sufficiently destructive, as shown, for example, in the older areas, a simulation of any of the structural diseases of the cord may result, but even then the severity of the symptoms stands in no proper relation to the gross extent of the lesions.[35] The tendency to remissions is doubtless explained by a refunctioning of neurons, inhibited and not destroyed by the rapid development of the plaques, presumably under inflammatory conditions, much as the cranial nerves behave in epidemic encephalitis.

Interest centers particularly about the disturbances of motility in relation to predominant spastic conditions, about the relatively slight sensory defects, in spite of extensive lesions in sensory tracts, and about the rare lesions of the peripheral motor neurons sufficient to produce muscular atrophy. A tendency to spasticity is probably to be regarded as the most common sign of the disease and one of the most prolific causes of faulty diagnosis. It is usually an early sign as in my personal observation of Case 9, a case in which for a considerable period a spastic paraplegia dominated the clinical picture. More interesting and difficult of explanation are cases such as these described by Oppenheim,[36] in which after the development of a well-defined syndrome of multiple sclerosis, a spastic paraplegia later developed, confusing the diagnosis. Case 13, abstracted in the following pages, at one period so closely simulated amyotrophic lateral sclerosis that for a time the diagnosis was in doubt although earlier there had been no question of the existence of multiple sclerosis, which the necropsy confirmed.[37] Climenko [38] describes a case of spastic paraplegia with changing level in which a laminectomy was performed, with discovering the cause. The subsequent course of the disease led him to the assumption, doubtless correct, that he was dealing with multiple sclerosis. This case bears a strong resemblance to Case 12 of my series.

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[35] André-Thomas and Comte: Rev. neurol. **14**:86, 1906. A case of paralysis of all the extremities with contractures. Necropsy revealed multiple sclerosis limited largely to the cord and particularly involving the pyramidal tracts.

[36] Oppenheim: Berl. klin. Wchnschr. **33**:184, 1896.

[37] Pitres: Rev. mensuelle, 1877, p. 992, describes the amyotrophic type; many have been described since.

[38] Climenko: New York Neurological Society, J. Nerv. & Ment. Dis. **49**: 310, 1919.

Whatever the reason may be, the afferent tracts suffer much less symptomatically than the efferent corticospinal tract. General cutaneous sensibility is, as a rule, slightly affected, the sphincters more often and extensively, possibly because of the motor element in the reflex (see case reports). There are sparing descriptions of true muscular atrophy. Spiller, in the article already alluded to, speaks of atrophy as pronounced in the arms and legs, especially in the small muscles of the hand in one of his patients. A patch in a ventral horn of the lower lumbar region is pictured, and alterations of nerve cell bodies were observed. This matter is also discussed in detail by Probst,[39] but the question is not elucidated by the statement that changes in the cell bodies occurred in the upper cervical region of one case observed by him in the absence of any sclerotic focus in that region. One naturally suspects an association with an ordinary progressive muscular atrophy. In Case 13 of my series examined clinically and microscopically by Dr. Hugo Mella, the possible relation of muscular atrophy to lesions of the cervical cord with degeneration of ventral horn cells was demonstrated. It should also be borne in mind that numerous cases are on record in which symptoms simulating multiple sclerosis have been shown after death to be due to other causes, especially studied in this country by Spiller. Among these may be cited Spiller and Wood,[40] confusion with syphilis; Spiller and Camp,[41] transverse myelitis; Spiller,[42] malaria; Weisenburg and Ingham,[43] hypoplasia of the brain; Mills and Spiller,[44] arteriosclerosis; personal cases reported, Cases 6, 8, 12 and 13.

The original separation of multiple sclerosis into a spinal and a cerebral form has little to commend it because in the vast number of cases the degeneration is both cerebral and spinal. From the clinical standpoint, however, it is advisable to make certain subdivisions with the understanding that the symptoms of the various types are due predominantly to lesions in certain areas without in any sense presupposing that the lesions occur only in those areas. Marburg,[45] on the basis of the widening clinical and pathologic investigations, suggests this classification: (1) a sacral form in which the symptoms, chiefly of sphincter control, point essentially toward the lower cord; (2) a cervical form to which Cassirer has drawn particular attention; acute ataxia usually one-sided, stereognostic disturbances, slight spastic conditions and sensory disorders are characteristic; (3) a bulbar form with symptoms referring particularly to articulation, deglutition and other bulbar disturbances; (4) a pontile form involving particularly the facial and trigeminal nerves; (5) a cerebellar type characterized by asynergy; (6) a hemiplegic or hemiparetic form ushered in by apoplectiform attacks.[46] A seventh form may be added in which ocular disturbances occur early and confuse the diagnosis; and, finally, an eighth in which spastic spinal conditions, including a disorder simulating amyotrophic lateral sclerosis, are predominant. These subdivisions should not be forced too far. They evidently run into each other, and it cannot be said that the lesions in any case are limited to those portions of the central nervous system which the symptoms indicate. It is, particularly in these more focal cases, often confusing in diagnosis that a multiplicity and wide extent of the lesions often appear postmortem.

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[39] Probst: Deutsch. Ztschr. f. Nervenh. **12**:447, 1898; a valuable and searching analysis of a case with correlation of symptoms and lesions.

[40] Spiller and Wood: J. Nerv. & Ment. Dis. **36**:373, 1909.

[41] Spiller and Camp: J. Nerv. & Ment. Dis. **31**:433, 1904.

[42] Spiller: J. Nerv. & Ment. Dis. **31**:643, 1904.

[43] Weisenburg and Ingham: J. Nerv. & Ment. Dis. **37**:675, 1910.

[44] Mills and Spiller: J. Nerv. & Ment. Dis. **36**:747, 1909.

[45] Marburg in Levandowsky: Handbuch **2**:932.

PERSONAL OBSERVATIONS

The following cases are reported in abstract to illustrate some of the difficulties in correlation and diagnosis.

CASE 1.—Sc. Transient ocular palsies, dimness of vision, tremor of head and hands, weakness of legs, attacks of falling, incontinence, final typical picture of multiple sclerosis. Necropsy: Complete transverse lesion of lower cord with extensive degeneration of other portions, ventral and dorsal root degeneration, especially of the cauda equina, all cranial nerve nuclei in the brain stem involved; brain not examined otherwise.

In this case there was essentially complete sclerosis of the optic nerves and tracts about the chiasm, although in the clinical notes only dimness of vision is mentioned. One would also have expected more than transient ocular palsies. The tendency to fall, general weakness and incontinence, find an explanation in the extensive cord lesions completely transverse at one point, but there were less symptoms than one would have expected in so apparently complete interruption of tracts.

CASE 2.—S. Uncertainty of gait, disturbance of vision, vertigo, remission, weakness of the legs, tremor, mental failure, change in speech, pain in the legs, paresis of the legs, slight facial involvement, paresis of the external eye muscles with diplopia, nystagmus, pallor of the temporal side of the disk, irregular narrowing of the fields, especially for colors, active knee reflexes, sensibility for the most part unaffected, finally paraplegia, incontinence and moderate dementia. Necropsy: Widespread lesions of the brain and cord with involvement of the cauda equina, spinal roots and cerebellar cortex, cranial nerve nuclei invaded, in general with preservation of the nerve cells; involvement of the optic chiasm and optic nerves.

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[46] Lowrey: Am. J. Insan. **74**:395, 1918. Hemiplegia (shock) at 26, convulsions through a period of years; postmortem, gliosis of left parietal lobe, with patchy gliosis of the cord diagnosed as multiple sclerosis. Marburg: Brain Tumors and Multiple Sclerosis, a Contribution on the Localized Form of Multiple Sclerosis in the Brain, Deutsch. Ztschr. f. Nervenh. **68**: and **69**:27, 1921. Abstr. in Nelson Loose Leaf Medicine, vol. 6.

The incongruity between lesions and symptoms is well shown in this case. Disturbance of vision only is mentioned although the chiasm was practically wholly invaded by sclerotic patches. Sensibility for the most part was unaffected in the presence of many lesions of the sensory tracts, especially in the cord, but also in the pons.

Case 3.—G. Examined by Oppenheim two days before death; scanning speech, probably complete bilateral external ophthalmoplegia, normal fundus, contractures, tremor of intention type, active reflexes, for six months rectal and bladder incontinence and dementia. Necropsy: Widely distributed lesions in the cord and brain, extensive cranial nerve involvement including the optic chiasm, many lesions in the capsule, centrum ovale and cerebral and cerebellar cortex.[47]

Correlations in this case are of small value because the physical examination, the report of which was available, was made so short a time before death. As given, the symptoms could not properly be accounted for by the lesions found, notably the complete external ophthalmoplegia.

Case 4.—F. N. D. Lameness and numbness of the right leg extending to the other side, improvement, articulation and vision disturbed, slight difficulty in swallowing, some ataxia, active knee reflexes, disturbance of sensation in the legs, fundus normal, again improvement; later irregularity of reflexes, crossed paralysis, spasticity, no intention tremor, nystagmus or characteristic speech defect. Necropsy: Predominating lesions of the spinal cord, nerve cells not markedly involved. This case was atypical throughout its course.

Case 5.—M. M. Emotional, sensitive to noises, speech defect, headache, staggering gait, numbness of the right hand, paresis of the right seventh nerve and of the left sixth, knee reflexes increased, nystagmus, no choking of disks, various disorders of sensibility, paralysis increasing up to death. Necropsy: Sclerotic areas throughout brain stem, no record of the cerebral hemispheres or of the cord; doubtful case during life, particularly because of well-marked sensory disturbances.

Case 6.—E. H. Active reflexes with double Babinski sign, gait weak and spastic, some numbness of the right leg, change of temperament, inequality of pupils, pain in the back and legs, muscular spasm, slow light reaction, incontinence. Necropsy: One large lesion found in the white matter of the brain and other smaller ones, numerous sclerotic areas in the cord; diagnosis of multiple sclerosis not made during life. The case suggested rather a diffuse combined degeneration of the Putnam-Dana type.

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[47] Cases 1, 2 and 3 reported in Deutsch. Ztschr. f. Nervenh. **5**:1, 1894.

Case 7.—E. F. Disturbed sensation in the legs, pain, difficulty in walking, knee reflexes active, double Babinski sign, some ataxia of the arms and legs, tremor of the hand, atypical scanning speech, nystagmus, increasing difficulty in walking, legs extended and spastic; no involvement of the cranial nerves, emotional, abdominal reflex absent, slight facial paralysis, speech becoming unintelligible. Necropsy: General distribution of plaques throughout the brain and cord with marked changes in the nerve roots.

Sparing sections were made from this case. So far as they are available for study the atypical character of the symptoms is somewhat adequately explained by the relative fewness of the sclerotic patches in the cord and brain.

Case 8.—C. F. R. First symptom, poor vision, staggering gait, pain, some lead found in the urine, later urinary retention, right arm weaker than the left, no objective disorder of sensation, active reflexes, cremaster and abdominal reflexes lacking, considerable unsteadiness of station, fundus normal at first examination, later suggestion of atrophy, defect of vision of the left eye; syphilis as well as lead poisoning suspected. Necropsy: Multiple sclerotic lesions. Detailed examination not made by me.

The course in this case was typical with typical lesions except that the cord appears less involved than the brain and the spastic paraplegia dominating the clinical picture for a considerable time finds no adequate explanation.

Case 9.—M. S. Weakness of the legs, temporary but recurring facial paresis, special weakness developed in the right arm and leg. For a time a spastic paraplegia dominated the picture, slight ataxia, general weakness, reflexes active, Babinski sign, slight nystagmus, speech slow and scanning, spasticity of legs without sensory disorder, increasing difficulty in walking, later extreme volitional tremor, typical scanning speech, nystagmoid movements, no continued paralysis. Pallor of temporal sides of disks, tremor of the diaphragm suggesting an intention type shortly before death. Necropsy: Cerebrospinal sclerosis, general and extensive.[48]

Case 10.—A. E. H. At 18 dragging of left foot, several falls; at 30 reeling gait with tendency to fall. Examined by J. J. Putnam and M. A. Starr. Speech defect at 37, obliged to use crutches; failing judgment, wheel chair at 43. Disease progressive with temporary improvement. For ten years unable to focus, external squint, irregularity of pupils, conversation unintelligent, mental defect well marked, no definite alteration in reflexes but tendency toward exaggeration, final difficulty in swallowing and extreme mental deterioration. Necropsy: Disseminated lesions of hemispheres, walls of the ventricles, pons and to a lesser degree in the cord.

The brain in this case was spattered with lesions, the cortex included; wherein may be found a somewhat unsatisfactory explanation of the pronounced mental changes resulting in dementia.

Case 11.—J. A. O. For six years pain in the right calf, later in the calf and ankle extending to the left side, walking became impossible, slow pupillary reaction, no knee reflex (due probably to contractures), ankle clonus and Babinski sign present, sphincter involvement, fundus negative, Wassermann reaction negative, no mention made of tremor, nysagmus or speech defect. Diagnosis during life: transverse myelitis.

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[48] Cases 4-9 reported in J. Nerv. & Ment. Dis. **33**:361, 1906.

First sacral, fourth and fifth lumbar pairs of dorsal roots cut for relief of pain and with the hope of relieving the high degree of spastic paraplegia. Necropsy: Sclerotic patches were found in the crura, pons, oblongata and conspicuously in the cord. In the crura there were two small areas of degeneration. In the quadrigeminal region a well marked area in the pyramidal tract, one side; in the upper oblongata one pyramidal tract markedly involved, in the lower both pyramidal tracts. Again in the cervical cord the predominant lesions were in the pyramidal tracts, but here the sensory areas were extensively invaded as well. In the dorsal region were extensive degenerations involving both motor and sensory tracts; in the lumbar region the plaques were not so pronounced.

This case is to a certain extent but not adequately explained by the lesions. At no time was a definite diagnosis of multiple sclerosis entertained. The symptoms pointed to a fairly sharp and circumscribed transverse lesion of the cord which did not exist. The marked spasticity with tendency to contracture is doubtless explained by the definite involvement of the pyramidal tracts; the extreme pain is altogether unusual though not undescribed (Nonne), and might be explained by involvement of the dorsal nerve roots which, however, was not demonstrated microscopically. The relatively slight sensory disturbance apart from pain is noteworthy in view of the lesions found. The case in general is of rather striking interest as demonstrating the great difficulty of correct diagnosis during life.

CASE 12.—C. B. Numbness and weakness of legs, girdling sensation, poor accommodation response in the left eye, tremor, absent abdominal reflex, exaggerated knee reflexes with double ankle clonus and Babinski sign, ataxia of the arms, a marked Romberg sign, spastic gait. In general, signs largely confined to the leg. Ayer double puncture, negative, colloidal gold paretic zone. Tumor of cord suspected during life; laminectomy and exposure of the cord showed various patches, presumably multiple sclerosis.

CASE 13.[49]—A. C. Onset with paralysis of legs, loss of sphincter control and intense headache. Pupils unequal and irregular, right hand grasp stronger than left, knee reflexes exaggerated, double clonus and Babinski sign, Romberg sign, persistent paralysis of the leg, disturbance of pain sense, increasing incontinence, scanning speech, vertical nystagmus, slight volitional tremor, emotional, probable left astereognosis, marked muscular atrophy, especially of the left arm and hand, with conspicuous exaggeration of reflexes and spasticity of legs. Diagnosis of multiple sclerosis was repeatedly made during the earlier course of the disease; toward the end possibility of an amyotrophic lateral sclerosis was strongly entertained. Necropsy: Typical lesions of multiple sclerosis, especial interest centering in the lesions of the cervical gray matter with reference to the pronounced muscular atrophy of the hand muscles.

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[49] I am indebted to Dr. Hugo Mella for the clinical history and preparation of sections in this case.

Microscopic examination of the ventral horn cells in the cervical region showed certain definite changes of degenerative character though by no means so extensive as one would find in well-advanced progressive muscular atrophy of the spinal type.

Case 14.—F. L. W. Onset with progressive weakness of the legs, associated with numbness and paresthesia, roughly up to the waist. Slight failure of vision, vertigo and tinnitus; nystagmus, both lateral and horizontal, right pupil larger than the left. Abdominal reflex bilaterally lost, loss of sense of position in legs, increasing and progressive weakness of the legs. Deep reflexes all increased but more in the legs than in the arms; ankle and patellar clonus, positive Babinski and Oppenheim response on both sides. Necropsy: Multiple sclerotic lesions of the cord with a small focus of softening in the thoracic region. The brain was not examined.

In this case the following tentative diagnoses were made during life: Tumor of the cord, combined sclerosis, transverse myelitis, and, as "a very distant possibility," multiple sclerosis. Tumor was thought to be so probable that a laminectomy was done, naturally with negative results. More importance should have been attached to the progressive weakness, the visual disturbances, the absent abdominal reflexes and to the colloidal gold reaction which was in the syphilitic zone in the absence of all other findings in the fluid suggestive of syphilis.

This group of cases illustrates in concrete form the difficulties of diagnosis and the impossibility of accurately correlating the clinical symptoms with postmortem findings. A cursory analysis emphasizes these points: A definite antemortem diagnosis was consistently made in only six cases, and one of these was doubtful during the latter part of life. The lesions stood in no predictable relation to the signs and symptoms during life, notably those of the oblongata and pons involving the cranial nerves. Several of the cases with generally disseminated lesions, strongly suggested sharply localized defects, for example, Case 11, transverse myelitis, Cases 12 and 14, tumor of the cord, Case 13, in late stages, amyotrophic lateral sclerosis. This is wholly in accord with the observations of many others and requires no further comment. It is evident that exact correlations cannot be made.

CONCLUSIONS

In summarizing this involved question the following conclusions appear to be warranted by the facts as yet at our disposal: As in other structural diseases of the nervous system, a general correlation may be made between lesions in certain localities and symptoms due to such lesions. It rarely happens that symptoms occur without any discoverable lesion. The degree of disturbed function depends on the age of the lesion, since the older the lesion the greater the destruction of nerve elements. The most satisfactory correlations have been made in connection with vision and the optic nerves and tracts. Sensory, motor or mental disorder may certainly be attributed to lesions occurring in the areas of the central nervous system disturbing these functions; but a precise determination of lesions from symptoms or of symptoms from lesions is not possible on account of the peculiar type of degeneration in the disease, particularly the long persistence of axons, the resistance of cells, and the multiplicity of lesions, which confuses the clinical picture. For instance, one is not justified in attributing mental changes to lesions of the cortex, when association tracts and deeper structures are also involved, nor can we say that ocular or other palsies are due to nuclear lesions when the cortical controlling areas or the connecting pathways are likewise involved. A wholly satisfying explanation of the so-called cardinal symptoms of the disease is not yet forthcoming. It is, however, fair to assume that the loss of myelin and the localization of lesions in coordinating areas are both, in part, responsible for the characteristic volitional tremor in its manifestation as nystagmus, speech defect and general ataxic tremor. Apart from these somewhat unique disturbances, the other signs and symptoms of the disease which are coextensive with the symptomatology of the nervous system in general, find their explanation in the multiplicity of the lesions, their localization and their degree of destructiveness. An attempt to draw accurate physiologic deductions is usually fallacious, and always misleading.

INCIDENCE OF MULTIPLE SCLEROSIS IN UNITED STATES TROOPS

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During the recent mobilization the neuropsychiatric officers examined approximately 3,500,000 men, draftees and volunteers. The examinations were made at the camps, and in the case of draftees, after acceptance by draft boards.

A total of 69,394 cases of nervous and mental disease and defects were identified. They were divided into nine clinical groups. The subhead under which multiple sclerosis was classified was entitled "Organic Diseases and Injuries." It included injuries, the general organic diseases of the nervous system, syphilis of the central nervous system (exclusive of paresis), a few minor conditions, such as tics, myasthenias, myotonias and other conditions. This group embraced 6,916 cases, about one-tenth of the total number.

Our method of approach to a determination of the frequency of multiple sclerosis is to determine its frequency, not in relation to the number of men examined, but in relation to other nervous conditions found in the particular group to which it belongs. For example, among 6,916 so-called organic cases, there were 511 cases of multiple sclerosis. We may say, therefore, that multiple sclerosis has a distribution average among organic conditions of 7.4 per cent.

Variations from this average occurred in certain states and in certain races. The variations in states was in approximate agreement with the results given in "Defects Found in Drafted Men." The variations as to races are given in the table.

Of the fractions given in the table, the numerator indicates the number of cases of multiple sclerosis found in the race, and the denominator indicates the total number of cases of general organic conditions in that race. The resulting percentage is the percentage of cases of multiple sclerosis as compared to organic conditions in that race. It will be observed that the percentage of cases of the disease in the Scandinavians, the French, the Slavs, the Scotch, the Germans, the English and the Irish all exceed the general distribution rate of multiple sclerosis. Also, there was an excess of cases in the foreign-born as compared with the native-born.

The average of foreign-born in the whole group of organic conditions was 9.2 per cent., while in multiple sclerosis it was higher, namely, 12.7 per cent. Thirty per cent. of the patients with multiple sclerosis gave a family history of nervous diseases (as compared with syphilis of the central nervous system, for example, in which only 7 per cent. of the patients had a family history of nervous diseases); 10 per cent. gave a family history of mental disease.

PERCENTAGE DISTRIBUTION OF MULTIPLE SCLEROSIS AMONG INJURIES AND DISEASES OF THE NERVOUS SYSTEM AS DETERMINED IN CERTAIN CLASSIFIED RACES

Total number of cases of nervous diseases and injuries..6,919
Total number of cases of multiple sclerosis.............. 511

Average distribution rate of multiple sclerosis...........7.4%

	Cases of Multiple Sclerosis	Cases of General Organic Diseases	Percentage
African	28	800	3.5
Dutch	4	38	1.0
English	74	913	8.1
French	11	102	10.7
German	35	418	8.3
Irish	41	516	7.9
Italian	10	191	5.2
Scotch	8	96	8.2
Scandinavian	16	127	12.5
Slav	18	181	9.0

LESIONS OF THE AUDITORY AND VESTIBULAR APPARATUS IN MULTIPLE SCLEROSIS

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These clinical studies of auditory and vestibular signs in multiple sclerosis are based on the examination of ten cases in which the diagnosis of this disease had been made. The examination divides itself naturally into: (1) a determination of the status of the sense of hearing; (2) the estimation of the presence or absence of spontaneous signs of disturbances in the vestibular apparatus, and (3) the observation of the character of the responses to experimental vestibular stimulation.

All ten subjects of this examination had normal middle ears. In none was there any disturbance of hearing, and there was no history of deafness. Transitory deafness, however, does occur as a symptom of multiple sclerosis, and has been reported by Beck[1] in two cases. In a third case, in which the diagnosis was not positive, there were temporary disturbances in hearing, of the nerve type. He believes this analogous to the transitory amaurosis, which occurs in multiple sclerosis. Hess,[2] Oppenheim[3] and Marburg[4] have also observed transitory deafness. Bárány[5] has reported a case of multiple sclerosis in which the diagnosis originally was acousticus tumor. This patient was operated on, and the tumor was not found. Subsequent to the operation, Bárány reexamined him, and found unilateral total deafness, with loss of nystagmus, following experimental vestibular stimulation, but with normal vertigo and past pointing. The original diagnosis of acousticus tumor was based on the erroneous assumption that the eighth nerve had undergone complete loss of function. The second examination showed the astounding peculiarity that, although nystagmus did not appear as the result of caloric labyrinthian stimulation, vertigo and past pointing did. Bárány concludes from this observation that the lesion could not involve the eighth nerve itself, but must be located in the brain stem beyond the point at which the vestibular fibers have separated into their tracts.

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[1] Beck, O.: Gehörorgan und multiple sklerose, Monatschr. f. Ohrenh. **47:** 875-877, 1913.

[2] Hess: Arch. f. Psychiat. **19:**1888.

[3] Oppenheim: Berlin klin. Wchnschr. 1896, p. 185.

[4] Marburg: Die sogenannte akute multiple Sklerose, Leipzig and Vienna: Deuticke, 1906.

[5] Bárány: Zur Differentialdiagnose zwischen Acusticustumer und multipler Sklerose mit bulbärem Sitz, Monatschr. f. Ohrenh. **47:**693-694, 1913.

NYSTAGMUS

With regard to the spontaneous signs of disturbances in the vestibular apparatus, the most important, perhaps, is nystagmus. This occurred in seven of the ten patients examined. Nystagmus was recognized by the older neurologists as a cardinal symptom of multiple sclerosis, and is considered an important one by modern neurologists. It occurs in a little over 50 per cent. of the cases. In the patients examined by me, spontaneous nystagmus occurred in all directions, that is, to both sides, upward, downward and obliquely. In some cases, several of these were combined. The spontaneous nystagmus, too, varies in type. As a rule, the lateral or horizontal nystagmus predominates. In one instance, there was a combination of rotary and horizontal nystagmus. The nystagmus is of two varieties: (1) oscillations of the eyeball, and (2) definitely rhythmic movements. A vertical nystagmus upward or downward occurred in four of the ten cases. This is considered pathognomonic of a lesion in the brain stem. One of the striking peculiarities regarding the spontaneous nystagmus is that it frequently persists despite the superimposed induced nystagmus, so that in response to cold caloric stimulation one may have a normal nystagmus directed to the side opposite to the ear which is stimulated, and yet the spontaneous nystagmus in some other directions will persist, and may even be accentuated. Occasionally it seems as if the spontaneous and induced nystagmus combine and cause most bizarre ocular movements. Another striking peculiarity in the patients examined was the loss of conjugate movements of the eyes, following induced nystagmus. Thus, in four instances, as the result of caloric stimulation, both eyes executed nystagmic movements, normal in their direction and plane, but differing in rhythm in the two eyes. Manifestly, the integrity of the mechanism that controls conjugate eye movements is essential to the normal play of induced vestibular nystagmus. In four of the ten cases, caloric stimulation caused a skew deviation, which did not occur spontaneously. In several instances, caloric stimulation was unable to produce definite responses. In one case, caloric stimulation of one set of vertical canals did not cause nystagmus, but did arouse normal vertigo and normal past pointing.

VERTIGO

Leidler[6] says that vertigo is a common symptom of multiple sclerosis. In none of the cases observed, however, was there at the time of examination any evidence of vertigo, as determined by the pointing tests. None of the ten patients showed spontaneous past pointing. In several of the cases, because of the tremendous intention tremor, pointing tests were impossible; but where they were made, the general direction of the arm movement was conserved, the tremor interfering only with the nice approximation of finger to finger. In no instance have I observed the hyperirritability described by Bárány. In fact, it has seemed to me that even when nystagmus following caloric stimulation approximated normal, vertigo was frequently suppressed, and nausea and vomiting never occurred.

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[6] Leidler, R.: Ueber die Beziehungen der multiplen Sklerose zum zentrale Vestibular-Apparat, Monatschr. f. Ohrenh. **51:** No. 56.

REPORT OF CASES

Case 1.—A. B., 41 years of age, had been ill for six years. Examination revealed: middle ears and tone limits normal; in the Weber test a vibrating tuning fork placed on the vertex was heard in the head, that is, not referred to either ear; Rinné's test, both sides, positive; Schwabach test normal; spontaneous nystagmus directed in both sides, more marked toward the right, also directed upward; no vertigo; no past pointing with either arm; rotation to the right after nystagmus of good amplitude, to the left, forty seconds; rotation to the left after nystagmus of good amplitude, to the right, thirty-five seconds; turning to the right, normal past pointing to the right, both arms; turning to the left, normal past pointing to the left, both arms; caloric test of the right vertical canals, feeble nystagmus, with normal past pointing; caloric test of the right horizontal canal, normal nystagmus, with normal past pointing. Caloric test of the left vertical canals caused no rotatory nystagmus to the right, but an increase in the spontaneous vertical nystagmus upward, with, however, normal past pointing to the left. Caloric test of the left horizontal canal gave a normal response.

Case 2.—W. F., 60 years of age, had been ill for thirty years. Examination revealed: middle ears and tone limits normal; no spontaneous nystagmus or past pointing; caloric stimulation of the left vertical and left horizontal canals aroused no nystagmus, but both arms past pointed 6 inches (15.24 cm.) to the left. This case was analogous to that described by Bárány, with the exception that hearing was normal. Caloric stimulation of the right vertical and horizontal canals gave normal responses.

Case 3.—J. C., 43 years of age, had been ill for six years. Examination revealed: both middle ears and tone limits normal; spontaneous horizontal nystagmus to the right and upward, none to the left; no vertigo or past pointing. Caloric stimulation of the left vertical canals was positive. There was normal vertigo with normal past pointing. Nystagmus following stimulation was of a peculiar dissociated type. Skew deviation also occurred, as well as an increase in the spontaneous nystagmus upward. Stimulation of the right side was normal.

Case 4.—O. H., 49 years of age, had been ill for nineteen years. Examination revealed: normal middle ears and tone limits; spontaneous, irregular, oblique nystagmus to the left; a combined rotatory and horizontal nystagmus to the right; an upward and a downward nystagmus. Pointing tests were impossible because of intention tremor. Caloric stimulation of the right vertical canals caused a definite increase in the spontaneous nystagmus to the left, but did not abolish the nystagmus upward or that to the right. Here, too, there were peculiar dissociated eye movements, resulting from caloric stimulation. and at times a skew deviation.

CASE 5.—J. S., 51 years of age, had been ill for fifteen years. Examination revealed: normal middle ears and tone limits; despite considerable intention tremor, normal pointing; a peculiar spontaneous dissociated nystagmus, more marked in the eye of the side toward which the eyes were directed, also a vertical nystagmus upward. Caloric reaction of the right vertical and horizontal canals was positive, resulting in a peculiar dissociated nystagmus and skew deviation, but arousing no vertigo or past pointing. Caloric test of the left vertical and horizontal canals aroused a similar response.

CASE 6.—A. S., 30 years of age, had been ill for seven years. At present he is bed-ridden. Examination revealed: normal middle ears and tone limits; Rinné's test, both sides, positive; Schwabach test normal; spontaneous nystagmus directed to both sides and upward; pointing test in the left arm impossible, in the right arm despite tremendous tremor, the direction of the movement was conserved, and although the arm oscillated somewhat, finger touched finger accurately. Caloric test of the left horizontal canal (impossible to sit up, therefore, vertical canals were not tested) caused marked response with slow nystagmus directed to the right; at times there was a skew deviation. There was no vertigo and no past pointing. Caloric test of the right external canal aroused a similar response and occasioned dissociated eye movements and slow nystagmus. There was no vertigo or past pointing.

CASE 7.—F. I. K., 55 years of age, had been ill for thirty years. Examination revealed: normal middle ears and tone limits; no spontaneous nystagmus and no spontaneous past pointing. The caloric test of the left vertical canal aroused a tardy, feeble response; in the left external canal it aroused a more nearly normal response. On the right side the results were similar, but neither labyrinth aroused vertigo or past pointing.

CASE 8.—A. M. W., 35 years of age, had been ill for seven years. Examination revealed: normal middle ears and tone limits; spontaneous lateral nystagmus directed to both sides; on looking upward, an oscillatory lateral movement in both eyes, much more marked in the right; no vertical nystagmus; no vertigo or spontaneous past pointing. Caloric stimulation of the left external canal aroused a horizontal nystagmus to the right, with normal vertigo and past pointing. Caloric stimulation of the right vertical and horizontal canals gave normal responses, with the exception of the asynchronous character of the nystagmus.

CASE 9.—L. F., 37 years of age, had been ill for three years. Examination revealed: normal middle ears and tone limits; coarse, nystagmic movements directed to both sides, chiefly right, none upward or downward. The pointing was fairly accurate, the direction being conserved, the tremor interfering only with the accurate contact with the finger. Caloric stimulation of the left vertical and horizontal canals gave normal responses. The vertigo, however, and the past pointing were slight. Caloric stimulation of the left labyrinth gave similar responses. The nystagmus resulting from caloric stimulation differed from the nystagmus in normal persons in that it was slower, more like a nystagmus of central origin.

CASE 10.—In I. C. both middle ears and tone limits were normal. Rinné's test was positive, the Schwabach test normal. There was no spontaneous nystagmus, no vertigo, no past pointing. Caloric stimulation of the right vertical canals and right horizontal canal aroused normal responses. Caloric stimulation of the left vertical and horizontal canals also aroused normal responses.

COMMENT

It would be exceedingly rash to dignify a discussion of the clinical data here presented by the term "conclusion," so much still rests on speculation and so little on definite knowledge. From these examinations, however, there have sprung certain suggestions which are at least worthy of mention:

1. The usual type of spontaneous nystagmus (namely, rhythmic), combined with the fact that it is frequently not amenable to influences aroused by vestibular stimulation, suggests that the origin of the nystagmus is a lesion in the vestibulo-ocular mechanism.

2. It is certain that as the result of vestibular stimulation, nystagmus and vertigo and past pointing may at times be aroused independent of each other. This may be true not only of the static labyrinth as a whole, but may apply also to the individual canals, at least to the vertical canals, as differentiated from the horizontal. These facts suggest a difference in location between the vestibular nuclei or tracts which intermediate nystagmus impulses and those which have to do with the sense of position in space.

3. It appears, further, from Beck's cases, that nystagmus, vertigo and past pointing may be aroused by experimental vestibular stimulation, and yet the falling cannot be influenced by changes in the position of the head. This fact suggests a difference in the location of the vestibular nuclei or tracts that intermediate so-called vertigo impulses to the extremities and those which transmit similar impulses to the trunk.

4. The presence of induced nystagmus with the total loss or marked suppression of vertigo, as seen in Cases 5, 6, 7 and 9, suggests the possibility of extensive disease of the cerebellar nuclei, or of the cerebellocerebral tracts, as the cause of this phenomenon.

5. Finally, it is clear that careful clinical study, combined with histologic research in cases of multiple sclerosis, will do much to clear up the shadows still overhanging an understanding of the anatomy and physiology of the central portion of the vestibular apparatus.

STUDIES IN THE PATHOGENESIS OF MULTIPLE SCLEROSIS *

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This article contains a brief review of the histopathologic changes in multiple sclerosis studied on material from thirteen cases. Two cases came from the neurologic service of Cook County Hospital; for two I am indebted to Dr. Peter Bassoe of Chicago; for one to Dr. Theophil Klingman of Ann Arbor, Michigan, and for eight to Dr. Alfons Jacob of Hamburg, Germany.

In addition, four other cases were studied; two apparently normal cords, one cord from a case of capsular hemiplegia and one from a case of Recklinghausen's disease. The findings were contrasted.

The best known and the most notable characteristic features of multiple sclerosis are the so-called patches of sclerosis. Scattered throughout the central nervous system and varying in size and form they preferably affect the white substance, its long or short nerve fibers; they may be symmetrical or asymmetrical and may invade even the peripheral nerves (Strahüber,[1] Schob[2]). Wherever located, whatever the size or age (young or old), there can be discerned in a patch many nerve fibers in fairly good condition. A great many are merely deprived of myelin, appearing as naked axons (demyelinated nerve fibers); some are partially covered with myelin, while others show a destruction of both the myelin and axon, exhibiting a state of wallerian degeneration.

These three pathologic features—apparently healthy fibers, fibers totally or partially demyelinated and fibers in a state of wallerian or secondary degeneration—occur not only in the patches themselves but also in parts of the central nervous system which show no visible

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* From the laboratories of the Illinois State Psychopathic Institute and Cook County Hospital.

* Presented before the second annual meeting of the Association for Research in Nervous and Mental Diseases, New York, Dec. 28-29, 1921.

[1] Strahüber, A.: Ueber Degenerations-und-Proliferationsvorgänge bei multipler Sklerose des Nervensystems, Ziegler's Beitr. z. path. Anat. **33**:409, 1903. Bemerkungen zu der Arbeit des Herrn Bielschowsky: Zur Histologie der multiplen Sklerose, Neurol. Centralbl. **23**:55, 1904.

[2] Schob, F.: Ein Beitrag zur pathologischen Anatomie der multiplen Sklerose, Monatschr. f. Psychiat. u. Neurol. **22**:62, 1907.

patches. Even an ordinary stain, that of Weigert-Pal for instance, brings out some of these features. Thus Figure 1 shows distinctly an old patch involving the posterior columns of the spinal cord where it appears as a pale island. On closer examination, with a hand lens or a microscope, one can discern in the colorless island a number of well preserved fibers in the shape of black dots. These represent a transverse section of normal nerve fibers separated from each other by empty spaces.

Between the pale patch and the normal-looking lateral columns there is an area containing a much greater number of nerve fibers of normal appearance. Such an area, termed intermediate, transition, adjacent or superimposed, is generally looked on as a young, undeveloped patch, the further growth of which has been prevented by death. An ordinary stain conveys the impression that an old patch grows by a gradual spreading in width, not respecting the neighboring tissues, the glia, blood vessels or the septums. It is also assumed that small plaques, gradually increasing in size, become coalescent to form a larger focus which sometimes may cover the entire width of the spinal cord.

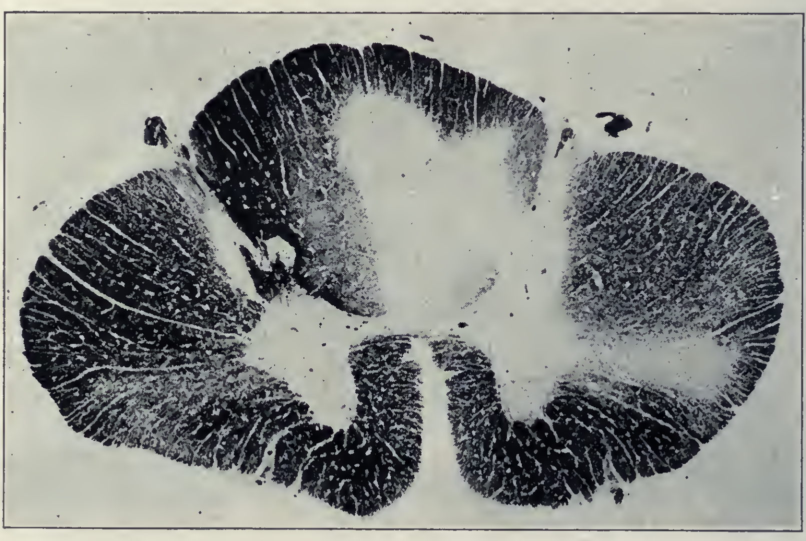

Fig. 1.—Eighth thoracic segment; patches in the posterior columns, the right lateral column and in the right posterior horn. The transition zone in the posterior columns, between the patch and the normal looking remnants of Burdach's columns, is marked. Weigert-Pal stain; × 13.

A much better idea as to the origin of a plaque, its growth and its relationship to the neighboring structures may be gathered from specimens stained with the methods of Marchi, Bielschowsky, Mallory-Jacob, Alzheimer-Mann, and especially with the combined staining methods of Marchi-Alzheimer-Mann or Bielschowsky-Alzheimer. The latter method brings out with remarkable clearness the various healthy and pathologic structures.[3]

Figure 2, a photomicrograph of a longitudinal section of an apparently healthy area stained with Bielschowsky and counterstained with the method of Alzheimer-Mann, shows very well the axons, the myelin and the glia. The axons show no particular changes, but the myelin sheath is tumefied, forming a broad swollen band around the well preserved axons. In many places the myelin appears fragmented,

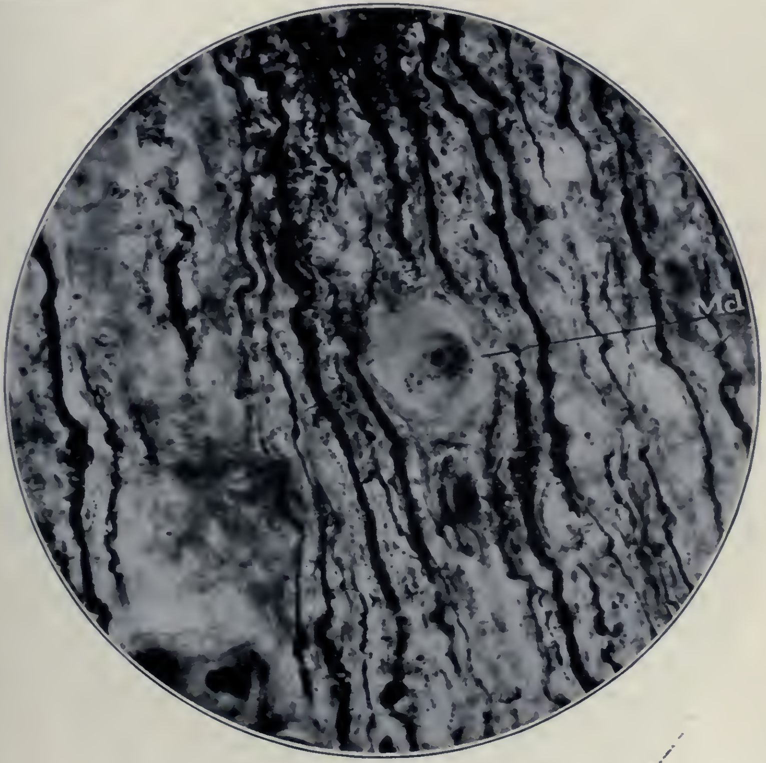

Fig. 2.—Longitudinal section of normal looking remnants of Burdach's columns. The black irregular lines are axons; the surrounding myelin either is swollen or shows minute globules (Elzholz bodies). Many of the black globules are parts of the axons which had been irregularly cut. In the center a myeloclast is seen within a large vacuole, *Mcl.* Use a hand lens. Bielschowsky-Alzheimer-Mann stain; × 560.

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[3] This combination stain has been described by me in "A Contribution to the Histogenesis of Syringomyelia," Archives of Neurology and Psychiatry **3**:130 (Feb.) 1920. In brief it is as follows: Bielschowsky sections not impregnated with gold are placed in a solution of phosphomolybdic acid (about 30 to 60 minutes), then in Mann's mixture (a 1 per cent. solution of methyl-blue eosin); differentiate in 95 per cent. and absolute alcohol.

broken up into globules and droplets. Under the oil immersion there can be observed in the myelin more or less wide meshes giving the myelin a reticulated or fenestrated appearance, as if it consists of numerous holes through which the axon can be distinctly seen. The distended meshwork of the myelin sheath frequently breaks down resulting in the formation of cavities, so-called "Lücken" (Fig. 3).

Marchi stained specimens, especially when counterstained with Alzheimer-Mann's or Mallory-Jacob's methods, exhibit, in addition to the marked swelling and fenestration of the myelin, numerous small black structureless droplets (Elzholz bodies) scattered along the axon and intermingled with fragments of broken up myelin. The myelin fragments may be of smaller or larger size, are made up of concentric layers, stained dark brown or black with osmic acid and are known as Marchi globules (Fig. 3 *M*).

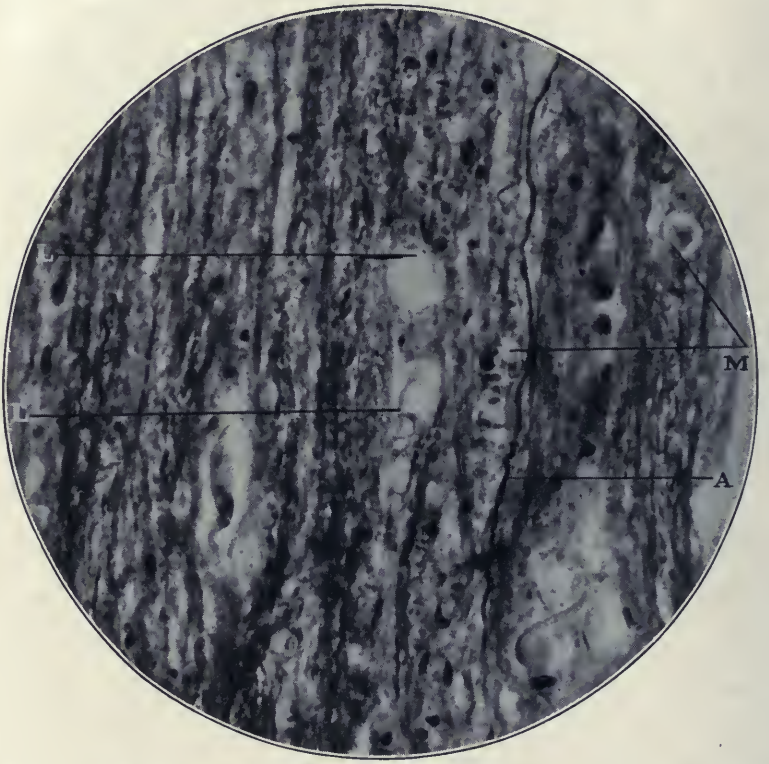

Fig. 3.—Longitudinal section of a "normal area." *A*, axon; *M*, myelin; broken up into globules (Marchi globules); *L,L*, "Lücken" crossed by an axon. The tissues between the axons are glia fibers and glia nuclei (dark round bodies). Bielschowsky-Alzheimer-Mann stain; × 450.

The outlined changes—swollen fenestrated myelin, its fragmentation with abundant formation of Elzholz bodies and Marchi globules in the presence of a well preserved axon—were found, in all of the thirteen cases studied, outside the patch proper, in areas which, with ordinary stains, appeared normal. The changes are exactly similar to those described as periaxial neuritis by Gombault,[4] Stransky[5] and especially well by Doinikow[6] in experimental degeneration of peripheral nerves. It would therefore be logical to assume that the earliest changes of multiple sclerosis obtained in the myelin are in the nature of periaxial neuritis.

The myelin changes, however mild, were always accompanied by marked proliferative phenomena in the glia tissue. The latter showed either as an increased amount of glia fibers filling up the spaces between the parallel running, swollen nerve fibers, or as large glia nuclei, rich in chromatin, invested by a visible, well-developed membrane and abundantly supplied with cytoplasm. The glia cells often appeared as

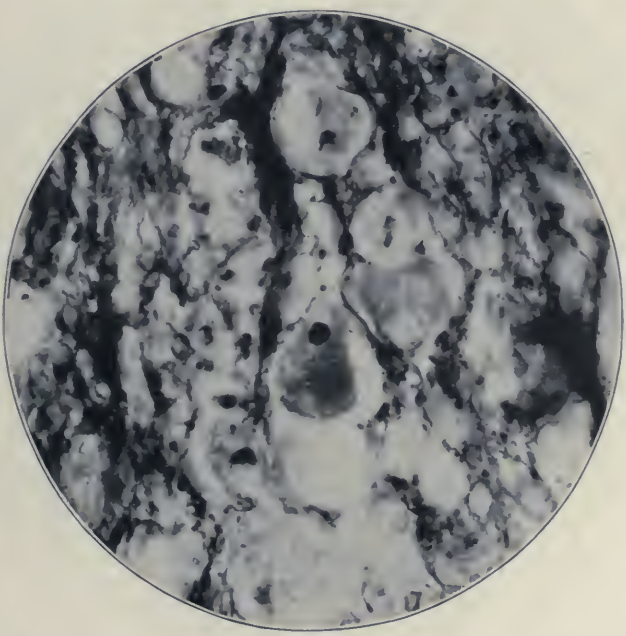

Fig. 4.—A group of myelophages. The one in the center of a large vacuole contains within one of its own vacuoles an amyloid body (use a hand lens). Mallory-Jacob stain; × 560.

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[4] Gombault, M.: Contribution à l'étude anatomique de la nevrite parenchymateuse subague et chronique. Nevrite segmentaire periaxile, Arch. de neurol., 1880-1881, vol. 1.

[5] Stransky, E.: Ueber diskontinuierliche Zerfallsprozesse an den peripheren Nervenfasern, J. f. Psychol. u. Neurologie **1**:169, 1903.

[6] Doinikow, B.: Beiträge zur Histologie und Histopathologie des peripheren Nerven, Nissl-Alzheimer's Arb. **4**:445, 1911.

large astrocytes (Deiters' cells) with numerous branching processes, breaking up into thin fibrils. Other glia cells, again, appeared greatly changed. They were lying within vacuoles, and presented large, somewhat broken-up granular cell bodies with an eccentric pyknotic nucleus and contained within their cytoplasm minute droplets of lipoids. These gliagenous formations are myeloclasts (Fig. 2, *Mcl*) described by Jacob[7] in the earliest stages of secondary degeneration of the central nerve fibers.

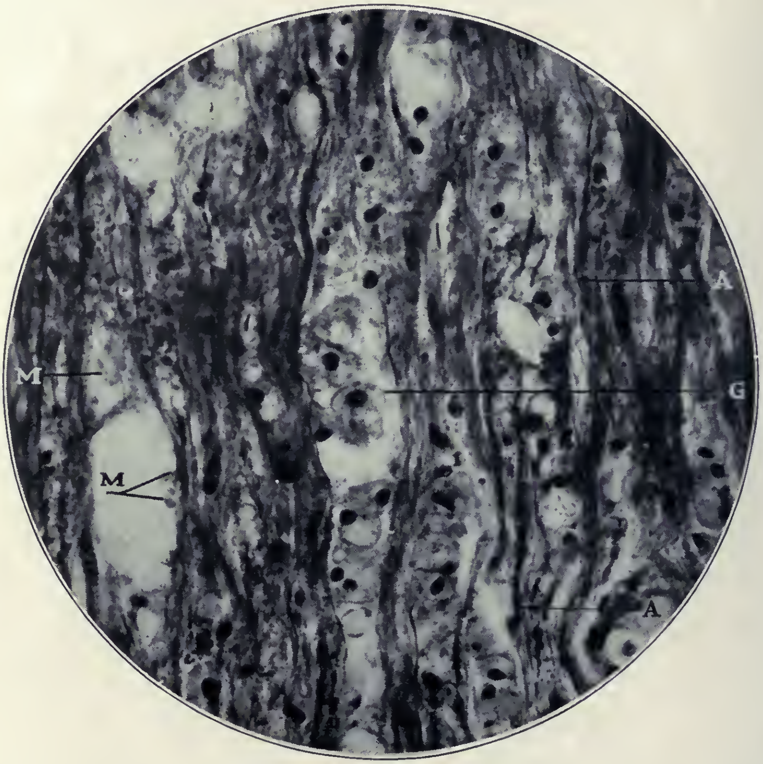

Fig. 5.—Transition zone, longitudinal section. The axons, *A,A,* are fewer though well preserved. Many "Lücken" show fragments of myelin, *M,M;* *G* indicates the space occupied by gitter cells, α and γ varieties; the black bodies are nuclei of gitter and other glia cells. Bielschowsky-Alzheimer-Mann stain; × 300.

Equally marked were mesodermogenic changes in the blood vessels, pia and its septal prolongations. They all exhibited a pronounced hyperplasia and thickening, dilatation of the perivascular adventitial spaces which were packed with gitter cells and distention of the pial meshes.

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[7] Jacob, A.: Ueber die feinere Histologie der sekundären Faserdegeneration in der weissen Substanz des Rückenmarks, Nissl-Alzheimer's Arb. **5**:1, 1912. Experimentelle Untersuchungen über die traumatischen Schaedigungen des Zentralnervensystems, Ibid., pp. 182-333.

CHANGES IN THE INTERMEDIARY ZONE

Much more in evidence were the ectodermogenic (nerves and glia) changes in the intermediate area, or, where this was not well formed, in the regions adjacent to the plaque proper. The Marchi globules which began forming in the "healthy" areas were here more numerous. The axons were usually well preserved; sometimes they were slightly tumefied, finely granular, twisted and occasionally broken up into minute fragments. Both the myelin (or Marchi) globules and the fragments of the axons were enveloped by glia rings or were enclosed within gliogenous cell bodies containing larger or smaller vacuoles and an eccentric chromatin-rich nucleus. These are Jacob's myelophages (Fig. 4) which, according to this investigator, pick up the broken-up nerve tissue and transform it within their vacuoles into fatlike (lipoid) substances.

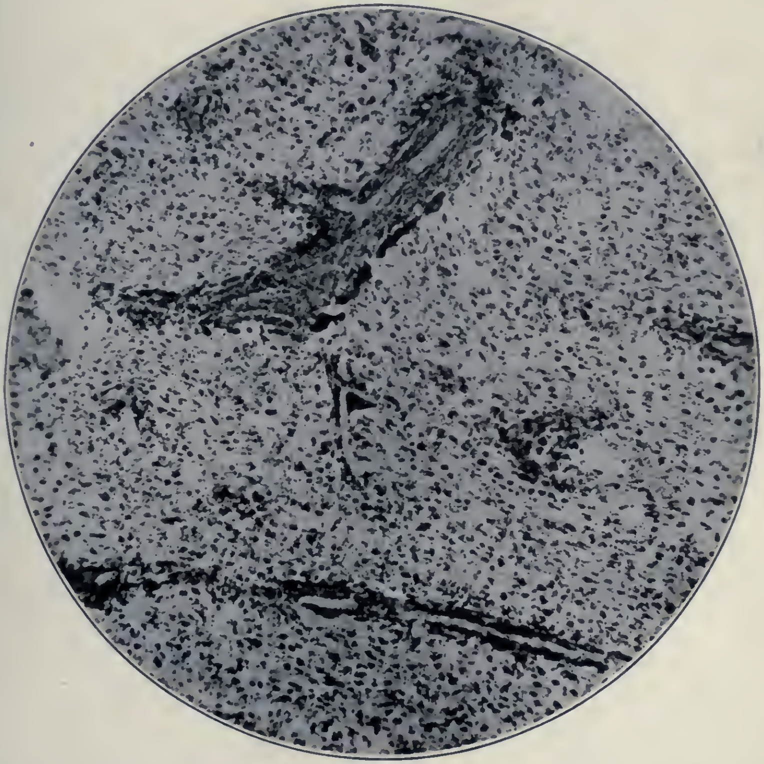

Fig. 6.—Vessels infiltrated with gitter cells. The entire field is covered with fat laden gitter cells appearing as so-called "fat granule myelitis." Herxheimer scarlet red stain; × 60.

These lipoids are found in larger masses within a third type of gliogenous formations, generally known as gitter cells or fat granule bodies (Fig. 5). The latter, as well as the myelophages, denote a further, more advanced, stage of secondary nerve degeneration than the stage of Marchi globules and myeloclasts.

The gitter cells generally appear as fine reticular honey-combed bodies harboring within their delicate vacuoles the lipoids resulting from the digestive activities of the myeloclasts and myelophages. In human pathologic material it is possible to follow up the transitions from a myelophage to a gitter cell which thus most probably represents a further evolutional stage of myelophage. Jacob[7] holds that the gitter cells, like the myeloclasts, undergo regressive changes, after the process of transformation of the broken-up myelin and axon is accomplished. Many gitter cells still show a large vacuole with remnants of nerve tissue within (gitter cell α), some show large vacuoles packed with large globules of lipoids (gitter cells β) and some show only minute vacuoles filled with very small droplets of fat. The cells

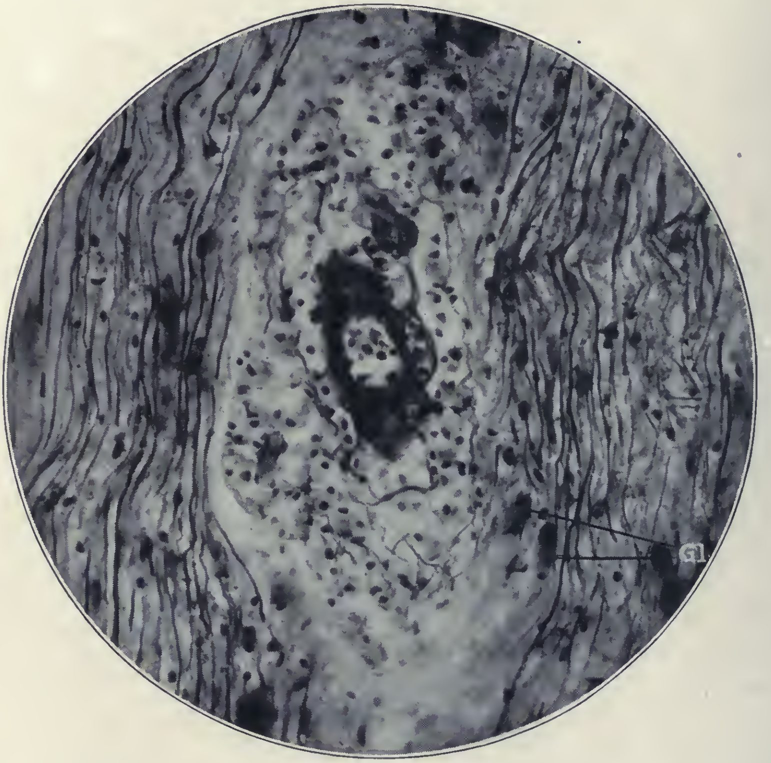

Fig. 7.—Blood vessel with a dilated adventitial space (Virchow-Robin) packed with gitter cells. The surrounding axons are well formed; *Gl,* protoplasmic glia cells which are very numerous here. Bielschowsky stain; × 260.

of the last variety are round and appear freely scattered over the field of vision as well as in large masses around the vessels or between the glia fibers and even in the pia (gitter cells γ).

The presence of vast numbers of various fat laden gitter cells gives the field of vision a characteristic appearance (especially when stained with osmic acid, scarlet red [Fig. 5] and similar strains) described by some authors (Dawson,[8] Klingman[9]) as the stage of fat granule myelitis. In general, such an area in no way differs from that resulting from secondary degeneration, for instance, of the lateral spinal cord columns following internal capsular destruction.

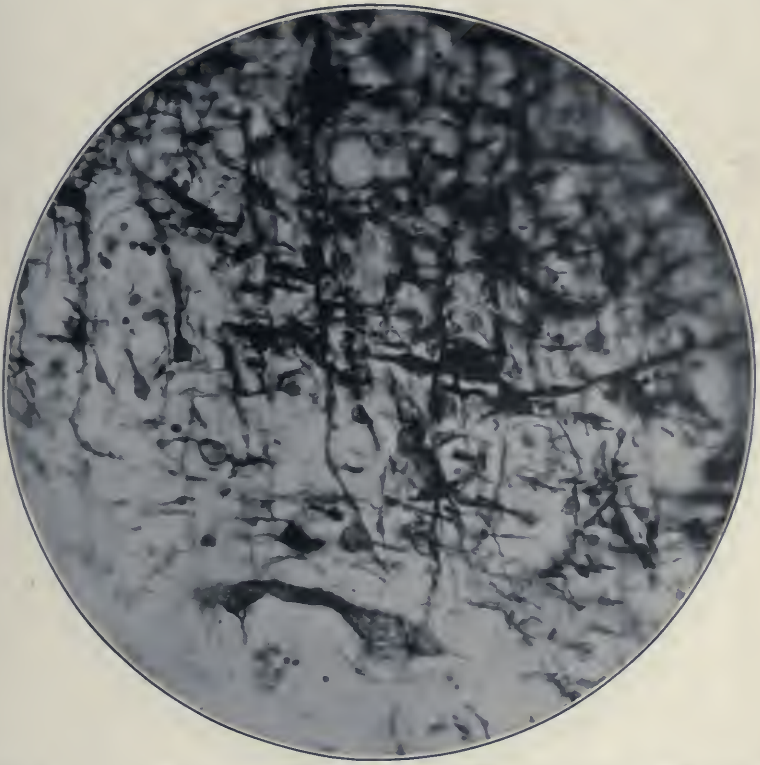

Fig. 8.—Cortex; swollen myelin fibers; the lower nerve fiber shows fenestration and swelling; others are bulb shaped, spindle shaped or varicose. Frozen section stained with Weigert-Pal; × 300.

The vessels in the intermediate area are more numerous but show the features outlined in the foregoing—the walls are thickened but usually dilated (Fig. 7), the dilated spaces containing an enormous number of gitter cells (γ variety). In toluidin blue, thionin, hematoxylin-eosin, van Gieson and similar stains such infiltrated blood vessels suggest at first glance an inflammatory condition, as if the infiltration consists of lymphocytes, plasma cells and similar hematogenous elements. Such an error can easily be corrected by having the specimens stained with osmic acid or scarlet red which will show that the infiltrating cells are fat granule bodies (gitter cells). The latter are the principal constituents of the infiltrated adventitial spaces; lymphocytes, polyblasts and plasma cells were exceptionally rare, and only in the brain substance, not in the cord, and even when present were greatly changed and degenerated. Polymorphonuclear elements did not show at all.

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[8] Dawson, J. W.: The Histology of Disseminated Sclerosis, Proc. Royal Soc. of Edinburgh **50**: 1914; Rev. neurol. & Psychiat. **15**:47, 367, 1915; **16**:287, 1916; Edinburgh M. J., N. S. **17**:229, 311, 377, 1916.

[9] Klingman, T.: The Histogenesis of Multiple Sclerosis, Arch. Neurol. & Psychiat. **1**:39, 193 (Jan., Feb.) 1919.

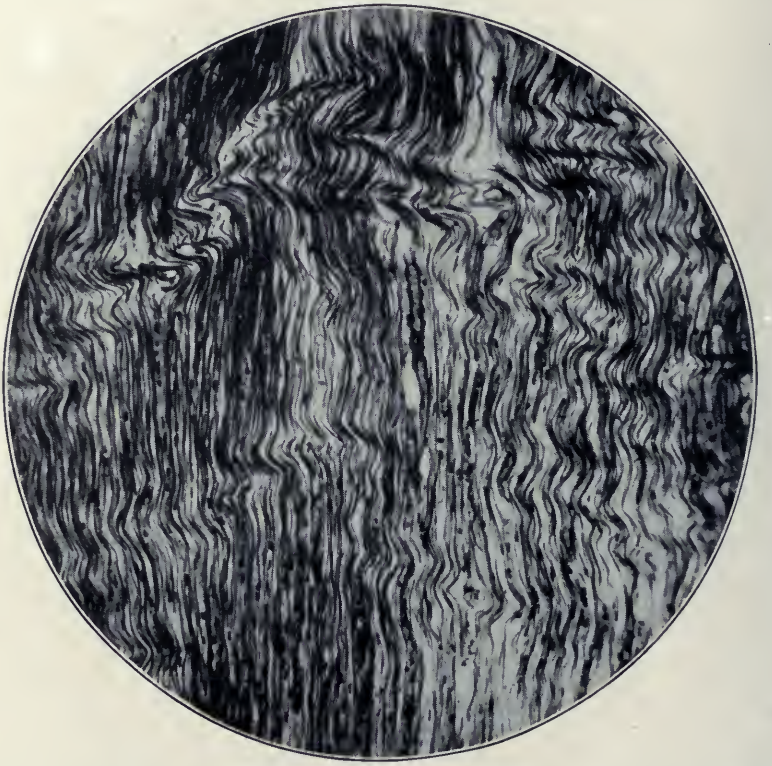

Fig. 9.—Patch of sclerosis represented by a glia tissue scar. The undulating lines are glia fibers covered with numerous glia nuclei. Vessels are few; axons present but few. Bielschowsky-Alzheimer-Mann stain; × 140.

Some blood vessels or capillaries were devoid of infiltration; the adventitial spaces were not dilated but on the contrary collapsed and thickened, often exhibiting numerous nuclei; the lumen, as a rule, was unobstructed, the endothelium very prominent.

The great number of blood vessels infiltrated with gitter cells or possessing thickened walls is another characteristic feature of the transition zone. Yet even here one may find numerous Marchi globules, many nerve fibers, swollen and reticulated (Fig. 8) and even nerve fibers in a fairly good condition. In short, the transition zone is made up of nerve fibers in various stages of degeneration, in no way differing from changes described by Jacob in secondary degeneration.

It is only proper to point out that a transition zone is often lacking, that is to say, a patch frequently ends abruptly without shading off into an apparently normal area. Yet, even in such instances there can be found, in the vicinity of the patch, nerve fibers in a state of advanced degeneration as outlined in the foregoing (Fig. 8).

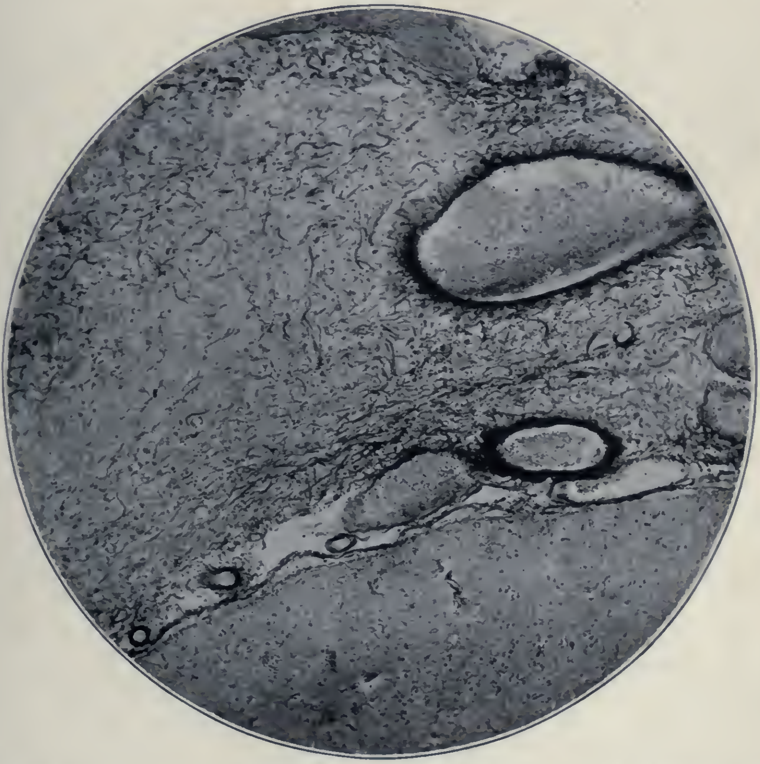

Fig. 10.—An enormously hyperplastic pia-arachnoid; the vessels, mostly veins, are also hyperplastic; the brain tissue (the lower half of the picture) shows distinct small vessels with thickened, not infiltrated, walls. With the help of a hand lens, many infiltration cells can be seen in the meshes of the pia-arachnoid as well as other changes. Alzheimer-Mann stain; × 60.

PATCH OF SCLEROSIS

After the broken up fragments of myelin and axons have been transformed by the action of the myeloclasts, myelophages and gitter cells into lipoids and removed to the mesodermogenic tissues—blood vessels and the pia-arachnoid, in other words, after the damaged tissues have been cleaned up and freed of the scattered débris, the destroyed nerve tissue is replaced by a so-called glia tissue scar, a patch of sclerosis (Fig. 9). In its typical form it consists of very thin neuroglia fibrils emanating from richly stained oval or rodlike nuclei, and so thickly packed that hardly any interspaces can be discerned. In other instances, there is an abundance of cytoplasmic glia cells, homogeneous in appearance, possessing an eccentric chromatin-rich anucleus and a great mass of thin processes. Again, there are instances in which the glia scar does show interspaces. The size of any interspace is very small, one gitter cell being sufficient to fill it up. Scarlet red stain shows, in a glia scar, an abundance of minute, dustlike droplets of lipoids enclosed either within the glia nuclei and gitter cells or scattered over its surface.

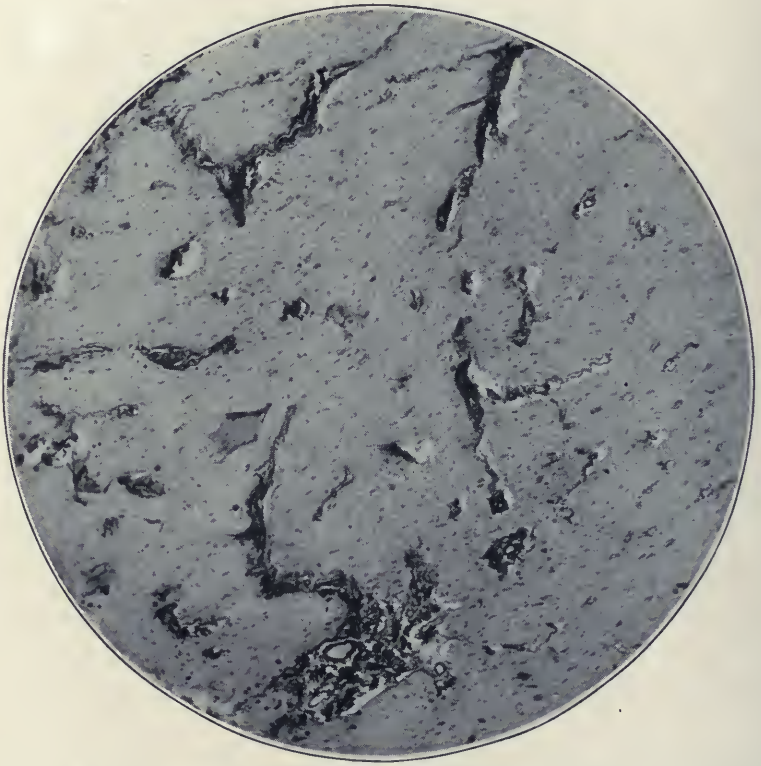

Fig. 11.—Optic chiasm covered with thickened hyperplastic vessels and pial septums. Mallory-Jacob stain; × 10.

Notwithstanding such severe destruction, a stray nerve fiber covered with myelin may be encountered even in such deserted areas. More commonly, however, the scar tissue exhibits nerve fibers deprived of myelin, that is to say, nerve fibers represented by naked axons, running wavelike and parallel to the glial fibrils. They usually appear thinned, granular, distinctly fibrillar and often are difficult to differentiate from the glia. New formed or regenerated axons, as described by Popoff,[10] Strahüber,[1] Doinikow [11] and others, could nowhere be found. Blood vessels in the scar tissue are less conspicuous than in the intermediary area. They often show masses of lipoids within the adventitia, which is usually thickened. Inflammatory phenomena, as in previous stages, were absent.

The scar patch is thus to be considered the final stage of nerve degeneration which began as swelling and fragmentation of the myelin (Marchi-globule stage), continued as a stage of myelophage and gitter cell activity and ultimately resulted in the formation of a glia scar. The three consecutive stages of a patch evolution [12] in multiple sclerosis are thus entirely analogous to those observed in experimental secondary degeneration so well described by A. Jacob.

Pronounced and widespread as the nerve destruction is, the gray matter proper (of the spinal cord, large subcortical ganglions, cortical nerve cells) is hardly involved. As a rule, the cell bodies are normal, but they may show phenomena of axonal reaction, neuronophagia, chromatolysis, pigment and fat accumulation, etc. Whatever changes the ganglion cells may exhibit, they are insignificant compared with those of the white substance and may justly be considered as secondary or accidental.

As secondary phenomena should also be considered the changes displayed by the mesodermogenic elements—the pia-arachnoid, its septal prolongations, the blood vessels and the choroid plexus.

The pia-arachnoid was always changed—thickened and infiltrated (Fig. 10). The thickening was closely associated with hyperplasia of its constituent elements (mesothelial and connective tissue cells), while the infiltration consisted of lymphocytes, plasma cells, polyblasts, gitter cells, many fibroblasts and also mesothelial cells. The majority of the infiltration elements were greatly changed, the lymphocytes, for instance, showing as dark, pyknotic nuclei, without any vestige of cytoplasm, while the plasma, as well as the gitter cells, were broken up and disintegrated. In addition, there were many red cells and macrophages packed with blood pigment.

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[10] Popoff, M.: Zur Histologie der disseminierten Sklerose des Gehirns und Rückenmarkes, Neurol Centralbl., 1894, No. 9.

[11] Doinikow, B.: Ueber De-und-Regenerationserscheinungen an Achsenzylindern bei der multiplen Sklerose, Ztschr. f. d. ges. Neurol. u. Psychiat. **27**: 151, 1914.

[12] Dawson speaks of six and Klingman of five stages which Klingman does not consider consecutive, while Dawson says the process does not always follow the same uniform course of development.

The cellular elements and their fragments were freely scattered in the meshes of the pia-arachnoid and in some instances were so densely gathered that the affected region resembled that of a meningitis.

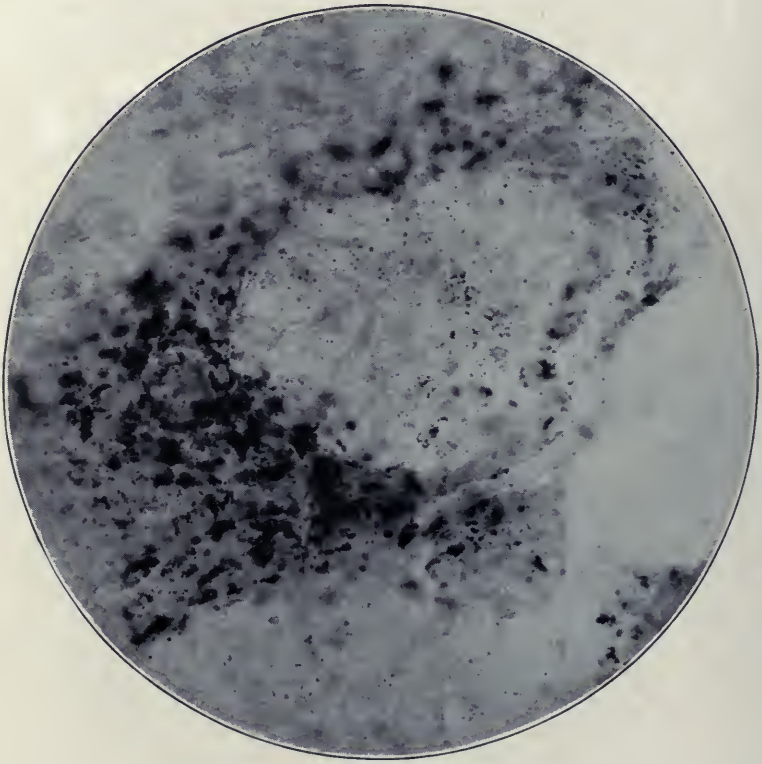

Fig. 12.—Fat accumulation in the pia (surface frozen section stained with scarlet-red-hematoxylin). Herxheimer stain; × 275.

The same hyperplasia and thickening, but without marked infiltrations, were present in the septal and cerebral prolongations of the pia, in the optic chiasm (Fig. 11) and in the blood vessels. Scarlet red and similar staining methods revealed, in both the pia and its vessels, masses of fat droplets enclosed within gitter and mesothelial cells. In some regions the pia was so densely packed with lipoid masses that these completely overshadowed other structures (Fig. 12).

As noted previously, vascular changes were present in apparently healthy regions, in the intermediate zone and in the patches themselves.

In other words, regardless of the condition of the nerve tissues and the degree and extent of the lesion, the vascular changes were alike—distended adventitial spaces packed with gitter cells, hyperplasia and thickening of their walls. Some areas, especially in the cortex, showed a greater wealth of capillaries, but no signs of budding, no regressive changes (such as hyaline degeneration, for instance), no marked thrombi formation, and only exceptionally—inflammatory cells (lymphocytes, plasma cells, polyblasts, etc.). Nor were hemorrhages with reactive phenomena found, though occasionally pigment was present within macrophages found around smaller capillaries. (It was not possible to determine whether the pigment was fat or came from the blood.)

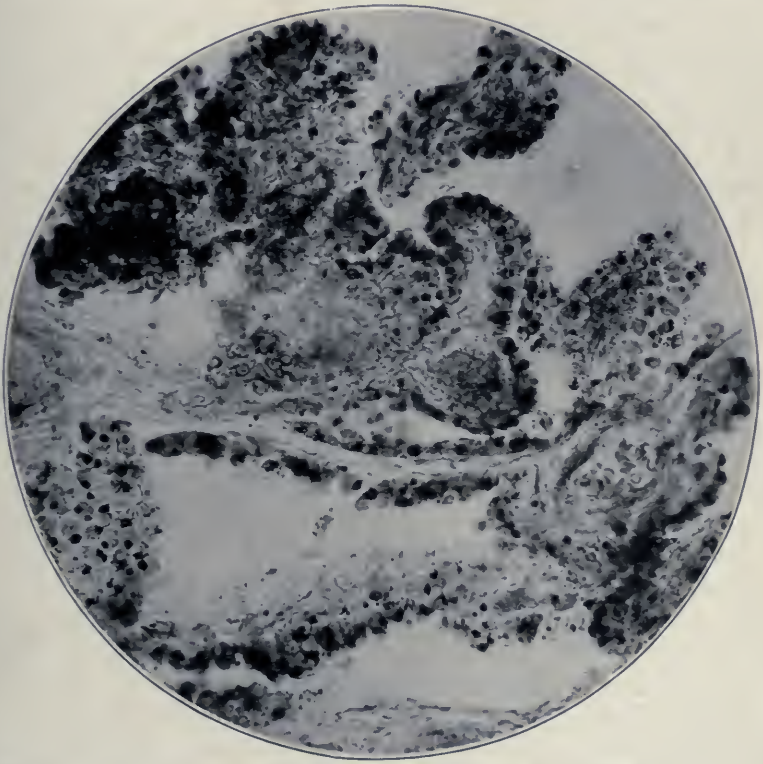

Fig. 13.—Choroid plexus; fat globules in the tuft cells (black dots). Herxheimer stain; × 230.

The choroid plexus (Fig. 13) invariably showed thickened vessel walls, absence of inflammatory phenomena and many fat globules within the tuft cells.

GENERAL SUMMARY

1. There were regressive and progressive ectodermogenic changes (nerve degeneration and glia proliferation) associated with pronounced

proliferative mesodermogenic changes (hyperplasia and thickening of the vessel walls, of the pia and the septums; dilatation of the adventitial spaces and their infiltration with gitter cells).

2. Absence of significant ganglion cell changes, of inflammatory phenomena and of any relationship of the nerve changes to the territorial blood supply was noted.

3. There was an abundance of lipoids in the pia-arachnoid and in the choroid plexus.

DISCUSSION

Of the foregoing phenomena, the most striking are the ectodermogenic changes. They show primarily as a nerve degeneration which goes through the same successive stages and obeys the same laws so well brought out by A. Jacob in experimental secondary nerve degeneration. He showed conclusively that the various morphologic glia changes, the formation of cytoplasmic glia, myeloclasts, myelophages, gitter cells and glia scar are all secondary phenomena, following a primary nerve destruction. The morphology of the glia and the type of its constituent elements (cell bodies and fibers) thus depend on the extent and severity of the parenchymatous lesions; in other words, the condition of the glia tissue denotes how far the nerve destruction has advanced.

The rôle of the glia, however, is not only to replace a destroyed parenchyma, but actively to remove it from the organism through the process of digesting the broken up nerve fragments and transforming them into harmless lipoid substances. When this is accomplished, the lipoids enclosed within gitter cells are carried to the adventitial spaces of the blood vessels and thence to the subarachnoid space.

In both the subarachnoid and the adventitial spaces, the fat laden gitter cells, as foreign bodies, cause an active proliferation of the constituent mesodermogenic or adventitial elements resulting in distention of the connective tissue meshes. With the removal of the invaders to the blood stream, the hyperplastic connective tissue of the blood vessel walls and the pia collapse and shrink, thus causing their thickening. The shrinking of the vessel walls may be so extreme as to cause a complete or partial separation of the vessels from the surrounding glia tissue and lead to formation of so-called His spaces, designated by Nissl and his school as "Schrumpfraume" (contraction spaces). Or the shrinking may be gradual and lead merely to the rarefaction of the adjacent glia with distention of its meshes, in short, to sievelike or "areolated areas." Such conditions (His spaces and areolated areas) have been considered by Borst [13] as the primary, essential cause of a patch formation. Without going into lengthy discussions of such a view, I wish to point out that similar conditions also occur in any brain, whether normal or pathologic, and that in multiple sclerosis the spinal cord, so rich in patches, does not show them at all. The phenomena outlined as observed in the adventitial lymph spaces, in the pia and in the perivascular areas, are purely secondary or accidental. They are found in areas devoid of patches and may be absent in regions profoundly changed, for they are due to the harboring of the destroyed parenchyma while on its way from the focus of destruction to the subarachnoid space. Distended adventitial spaces packed with gitter cells occur in any pathologic condition in which secondary degeneration is the principal feature, as, for instance, in amyotrophic lateral sclerosis, subacute combined cord degeneration and secondary cord degenerations. In short, the vascular, the pial and perivascular changes are not specific for multiple sclerosis and therefore cannot be considered the cause of the patch formation, its growth or dissemination. Nor does the patch follow the course of a blood vessel as Dawson and others have shown. Dawson,[8] for instance, studied small foci of sclerosis serially throughout their whole extent and came to the conclusion that they do not coincide with the vascular areas at all.

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[13] Borst, M.: Die multiple Sklerose des Zentralnervensystems, Ergebn. d. allg. Pathol. u. pathol. Anat. **9**^{I}:66, 1904. Zur pathologischen Anatomie und Pathogenese der multiplen Sklerose des Gehirns und Rückenmarks, Ziegler's Beitr. z. pathol. Anat. u. allg. Pathol. **21**:308, 1897.

As the principal or primary changes are parenchymatous and are confined to the nerve fibers, while those in the glia and mesodermogenic elements (vessels, pia, its septal prolongations) are secondary, it follows that were it possible experimentally to produce multiple sclerosis, connective tissue changes would be found, but as purely accidental, nonessential phenomena. So far, experimental multiple sclerosis has not been produced, nor is it possible to produce this disease either by interference with the blood supply or by irritation of the spinal cord.

Attempts to produce multiple sclerosis by injecting (intravenously, subcutaneously or intraperitoneally) spinal fluid from corresponding patients are theoretically fully justified. For such a cerebrospinal fluid discharged into the subarachnoid space is saturated with the products of catabolism or toxins which are the most probable cause of this morbid condition. The histopathologic findings are certainly quite typical of a toxic, not a microbic, lesion and do not resemble the lesions resulting from disturbed blood circulation.

Vascular disturbances, of the nature of embolism and thrombosis, may produce foci of necrosis with subsequent formation of foci of sclerosis. But such secondary sclerotic foci have little in common with those seen in multiple sclerosis. The same is true of the patches resulting from local irritation of the spinal cord substance. Thus, Leyden [14] by injecting liquor potassii arsenitis (Fowler's solution) into the spinal cord of dogs produced what he thought to be patches analogous to those seen in men, and he concluded that multiple sclerosis is the result of a myelitis. Westphal,[15] discussing Leyden's experiments, justly remarked that not every patch is to be considered the result of a previous inflammation.

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[14] Leyden, E.: Ueber experimentell erzeugte Rückenmarkssklerose und die Ausgänge der Myelitis, Charité Ann. **3**:248, 1876.

In other words, patches occurring in the central nervous system may be of various origins. Weigert-Pal stain, for instance, may show patches in cerebrospinal syphilis, disseminated encephalomyelitis, general paralysis of the insane, arteriosclerosis of the brain, traumatic cord and brain lesions, in short, whenever and wherever the parenchyma is directly involved. These morbid conditions may clinically and pathologically so much resemble multiple sclerosis that they have many times been mistaken for it by both clinicians and pathologists. The patches in the foregoing diseases, however, differ greatly from those seen in multiple sclerosis. Some will show inflammatory phenomena, as in encephalomyelitis, some will exhibit areas of softening, or, in addition to glia changes, also marked connective tissue proliferation (in syphilitic lesions), etc. In short, they will exhibit phenomena entirely foreign to the conditions seen in multiple sclerosis and on the other hand there will be lacking the characteristic features.

For multiple sclerosis has a pathologic constant in its pathogenesis, the changes starting as tumefaction of the myelin which, followed by the destruction of the axon, ultimately results in secondary degeneration —they begin as a periaxial neuritis and end as wallerian degeneration. The disease constantly affects new fibers which ultimately become replaced by a glia tissue scar. It resembles only subacute combined cord degeneration and peripheral nerve lesions caused by lead, alcohol or other poisons, described by Gombault,[4] Stransky[5] and especially well by Doinikow.[6]

Multiple sclerosis also resembles a peculiar morbid condition which I am now studying in which the dominant feature is also a degenerative process, but in which the changes are limited to the second stage.

CONCLUSIONS

1. In multiple sclerosis there are definite early changes in the form of widespread swelling of the myelin substance.

2. The myelin alteration is an acute and early manifestation with the formation of a waxy patch.

3. The glia undergoes changes later.

4. The pathologic changes are primarily ectodermogenic, the mesodermogenic tissue participating in the alterations of the disease secondarily.

5. Vascular and septal changes are present, but are accidental phenomena.

6. Theoretically it is possible to produce the changes of multiple sclerosis without concomitant changes in the connective tissue elements.

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[15] Westphal: Berl. klin. Wchnschr. **15**:121, 1878.

7. The patches of sclerosis are not representative of territorial areas in relation to the arterioles, the venules and the perivascular lymph drainage.

8. The lesions of multiple sclerosis cannot be produced experimentally either by interference with, or irritation of, the vascular supply or the spinal cord.

AN INVESTIGATION OF THE AXIS CYLINDER IN ITS RELATION TO MULTIPLE SCLEROSIS *

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It can no longer be doubted that in both the acute and chronic form of multiple sclerosis, the axis cylinder suffers distinct injury. On the other hand, no one will be inclined to doubt that in the presence of greatly advanced sclerotic patches, despite the advanced disintegration of the medullary substance, in both recent and old plaques, axis cylinders are still preserved. However, several questions regarding the axis cylinder are still unanswered, which by the application of modern methods of investigation may in time be cleared up.

What follows applies to a number of questions concerning the axis cylinder. The method used is that of Jakob (anilin blue and gold orange method, according to Mallory) which allows a distinct differentiation between the axis cylinder, the medullary sheath and the glia in the same section. We have also examined sections stained by the Bielschowsky method, for comparison—sections taken from acute cases, as well as from those in which the changes were frankly sclerotic. The changes the axis cylinder undergoes in multiple sclerosis are approximately the same as those described by Marburg[1] in the acute types of this disease. The outstanding features are thickening, globular distention, vacuolization, disintegration and, in the older sclerotic areas, the appearance of thin threads. One sees occasionally separated fibrillae pushed up or scattered along the periphery.

The absence of secondary degeneration in axis cylinders showing such serious deterioration is striking. It is possible that we are here confronted with certain edemas that are reversible in nature to a certain extent in the acute cases and to a less degree in the chronic types. Marburg has drawn a parallel between the changes observed in the medullary sheath in multiple sclerosis and those found in periaxial neuritis of the Gombault-Stransky type. According to him, the medullary sheath breaks up first, the axis cylinders remaining com-

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* This work was done in the Neurological Institute, Vienna, under Prof. Otto Marburg.

* Read before the Association for Research in Nervous and Mental Diseases at its Second Annual Meeting, Hotel Commodore, New York, Dec. 28-29, 1921.

[1] Marburg: Die sogenannte multiple Sklerose, Liepzig and Vienna: Deuticke, 1906; Multiple Sklerose, Handbuch der Neurologie, Berlin: Springer, **12**: No. 1, 1911.

paratively uninjured. This type of medullary disintegration, heretofore unknown in the central nervous system, has since been demonstrated by Shimazono[2] in animals subjected to experimental lead poisoning. In Shimazono's sections, however, one is impressed with the fact that the axis cylinder is not distended and edematous as observed in multiple sclerosis, but rather broken up into rows of granules, having previously become narrower and thinned out.

Kimura,[3] in his investigation into the degenerative and regenerative processes of the peripheral nervous system, reports similar changes, and he greatly restricts the term periaxial degeneration. This investigator also believes that primarily the axis cylinder is mostly injured in the neuritides. It is true he does not preclude the destruction of the medullary sheath around the still existing axis cylinder, yet he assumes that to bring this about there must be a serious lesion of the peripheral nerve. He adds, further, that in nerves in which the medullary substance has already broken up into clods, no well preserved axis cylinder is to be found. Since the axis cylinder perishes before the medullary sheath is entirely broken up, we must assume that a long smooth axis cylinder when seen in the field is formed of vacuolated fibers, at least as far as the peripheral nerves are concerned. This apparently contradicts the existence of a periaxial neuritis type of reaction.

Siemerling and Raecke,[4] in their comprehensive studies, maintain that the lesion of the nerve is primarily manifested in the axis cylinder. They believe the process originates in the vascular system, an hypothesis adopted by Fraenkel and Jakob,[5] who base their opinion on a study of the smallest areas just developing. A process originating in the vascular system and chiefly affecting the medullary sheath has been known for some time. This manifests itself particularly in pernicious anemia, in which the pathology of the changes has been by no means ascertained. It is attended by complete destruction of all the nerve fibers within a limited area.

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2. Shimazono: Ueber das verhalten der zentralen und der peripherer Nervensubstanz bei verschiedenen Vergiftungen und Ernährungsstörungen, Arch. f. Psychiat. **53**:972, 1914.

3. Kimura: Histologische degenerations und regenerations Vorgänge im peripheren Nervensystem, Mitteilungen aus dem path. Inst. der Kais., Japan. Universität zu Sendai **1**: No. 1, 1919.

4. Siemerling and Raecke: Beitrag zur Klinik und Pathologie der multiple Sklerose mit besonderer Berücksichtigung ihrer Pathogenese, Arch. f. Psychiat. **53**:385, 1914.

5. Fraenkel and Jakob: Zur Pathologie der multiplen Sklerose mit besonderer Berücksichtigung der akuten Formen, Ztschr. d. ges. Neurol. u. Psychiat. **14**: 565, 1911.

Shimazono, and more recently Wohlwill[6] have shown that in pernicious anemia the axis cylinder primarily is injured. The medullary sheath is at first only passively stretched. The glia then begins to proliferate by way of reaction and seemingly compresses the axis cylinder which it eventually absorbs after its disintegration; while the medullary sheath disintegrates in its turn, not into large clumps, but into small particles. At the same time a narrow line of medullary sheath attaches itself to the heavily degenerated axis cylinder.

We have, therefore, two distinct processes affecting the nerves—the one alleged to begin in the axis cylinder, the other in the medullary sheath. The existence of the latter cannot possibly be doubted if we examine longitudinal sections in multiple sclerosis. One may actually see the axis cylinder becoming uncovered and then recovered again at the far end of the small area. The line of thought pursued by Kimura is hardly justifiable. He assumes that a serious lesion exists remotely in the correlative nerve.

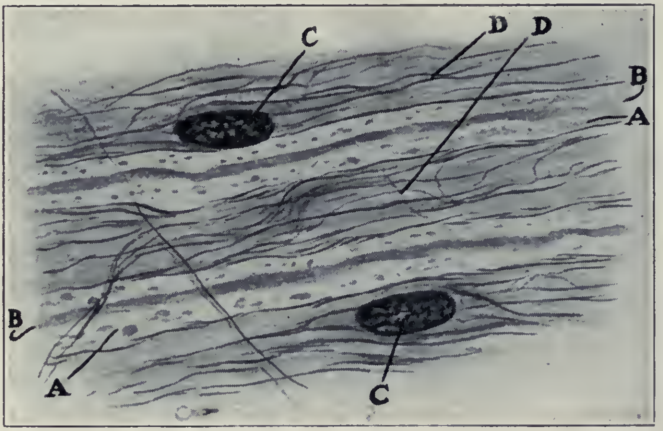

Fig. 1.—A well advanced stage of myelin disintegration; glia cells with pigment. *A,* myelin fragments; *B,* axis cylinders fairly uniform, although myelin disintegration is advanced; *C,* glia cells with pigment, broken down lipoids; *D,* glia fibers. Mallory stain, Jakob modification; oil immersion; ocular 8.

Apparently there is only one difference distinguishing experimental neuritis from the periaxial type accompanying multiple sclerosis—comparative slenderness of the axon and granular disintegration occurring overwhelmingly in the former while in the latter there is mostly swelling and distention.

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[6] Wohlwill: Zum Kapitel der pathologisch-anatomischen Veränderungen des Gehirns und Rückenmarks bei pernicioser Anemie und verwandten Affektionen. Deutsch. Ztschr. f. Nervenh. **68-69**:438, 1921.

Anton and Wohlwill: Multiple nichteitrige Encephalomyelitis und multiple Sklerose, Ztschr. f. d. ges. Neurol. u. Psychiat. **12**:31, 1912.

The question is whether the axis cylinder is primarily injured and the medullary sheath secondarily or vice versa. This cannot be decided from the study of histologic pictures alone. Examination of Jakob's slides shows that in the advanced stages of the majority of the cases the medullary sheath is completely destroyed, except that occasionally remnants are distinctly visible, a yellow tinted margin lying along the periphery of the axis cylinder. Occasionally even a nerve is found, as described by Wohlwill in cases of pernicious anemia, with an inflated axis cylinder and a relatively thin but as yet intact medullary sheath.

In both acute and chronic cases we see what Doinikow[7] has exquisitely shown—the button or globe-shaped inflations, either forming a club shaped nerve end or a globular distention along the axons. This is also mentioned by Minea.[8] A second question is that of regeneration of the axis cylinder. The following has been demonstrated in the Vienna

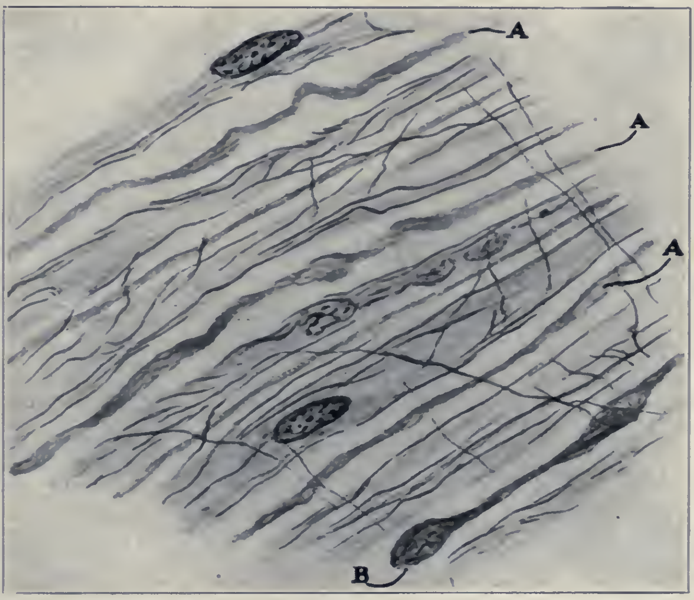

Fig. 2.—The myelin has entirely disappeared. The axis cylinders are surrounded by glia fibers. *A*, naked axis cylinders, uniform caliber gone, distorted in shape and showing vacuolization; *B*, an inflated end bulb type. Mallory stain, Jakob modification; oil immersion; ocular 8.

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[7] Doinikow: Ueber De- und Re-generationserscheinungen an Achsenzylindern bei der multiple Sklerose, Ztschr. f. d. ges. Neurol. u. Psychiat. **27**:151, 1915.

[8] Marinesco and Minea: Nouvelles contributions a l'étude de la régénescence des fibres du système, nerveux central, J. f. Psychiat. u. Neurol. **21**:116, 1910-1911.

Neurological Institute, by Miyake.[9] Only one day after complete section of the spinal cord, these spherical bodies and inflations were observed on the axis cylinders; that is, at a period when regeneration can hardly be considered. Consequently, it is impossible to infer that these tumefactions are indicative of regeneration. However, threadlike processes or fibrillae sprouting out of the globular distentions may perhaps be an indication of beginning regeneration, but regeneration would by no means account for the preservation in many areas of considerable numbers of naked axis cylinders still capable of conduction. Disintegration of the medullary sheath with comparative intactness of the axis cylinder must be regarded as a specific characteristic of multiple sclerosis. An explanation of the peculiar relationship between the axis cylinder and the medullary sheath may be found in the work of Spiegel of Vienna, who showed that every lesion of the medullary sheath must be followed by one in the axis cylinder for physico-chemical reasons.

The polarization microscope has shown us that the edematous nerve may return to its normal condition, providing the noxious influence has ceased to exist. The inference is that if the noxious influence continues, a lesion of the axis cylinder supervenes, and the degree of impairment of function depends on the degree of this lesion. This work tends to show that in pernicious anemia toxins injure primarily the axis cylinder. The form of disintegration of the medullary sheath in these two diseases is different. In pernicious anemia it is in small granules; in multiple sclerosis in coarse lumps. Presumably the different types of lesions are due to different poisons, not to varying strength of the same toxin.

In multpile sclerosis the neuroglia is comparatively free from serious involvement. An excessive fibrillar growth is its most striking feature, the axis cylinder becoming surrounded by a sheath of glia, a sort of envelop of delicate network.

CONCLUSIONS

1. The axis cylinder is damaged and may be destroyed.
2. Frequently the axis cylinders survive the lesion and the primary edema is followed by a subsidance of the same.
3. The medullary sheath is more seriously involved than the axis cylinder. It may be completely destroyed while comparatively well preserved axis cylinders remain.
4. The medullary sheath may be preserved, at least in part.
5. We accept Spiegel's conception that disintegration of the medullary sheath is accompanied by edema of the axis cylinder.

Harvey Building, 355 East 149th Street.

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[9] Miyake: Zur Frage der Regeneration der Nervenfasern im zentralen Nervensystem, Arbeiten aus dem Neurologischen Institut, Vienna **14**:1, 1908.

MULTIPLE DEGENERATIVE SOFTENING VERSUS MULTIPLE SCLEROSIS *

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Recent histopathologic studies of the central nervous system have brought to light a group of cases presenting peculiar lesions in the form of scattered foci of degeneration. These foci or plaques differ microscopically from the patches of multiple sclerosis, encephalomyelitis and similar conditions and may be the cause of many indefinite clinical syndromes. These probably include many cases described as degenerative encephalitis, disseminated encephalomyelitis, malignant or acute multiple sclerosis, poliencephalitis superior of Wernicke, and other conditions. Generally speaking, they do not conform, either clinically or pathologically, to any established morbid entity.

The histopathologic examination of such a case seems to justify the conclusion that we are here dealing with a disease group *sui generis* which we propose to designate as multiple degenerative softening in order to emphasize the contrast with multiple sclerosis.

CLINICAL REPORT OF A CASE (DR. BASSOE)

History.—A man, aged 28 years, was first in the Presbyterian hospital from June 8 to July 2, 1921, on account of an infection of the right middle finger for which he had been treated for three days previously. He was also found to have acute tonsillitis, catarrhal conjunctivitis and carious teeth. He complained of headache and generalized pain. At this time the reflexes were normal. The pupils and eyegrounds were normal. Vision was not taken as there was no complaint relating to it. During this stay in the hospital his weight decreased from 127 to 112 pounds.

He was readmitted ten days later, on July 12, complaining of frontal headache, failing vision, general weakness, difficulty in starting urination, spells of dizziness and ringing in the ears. Vision began to fail one week before admission. There had been no diplopia. On July 12 the blood pressure was: systolic, 92; diastolic, 64. There were 5,100,000 red cells, 8,200 white cells, and 94 per cent. hemoglobin. He could count fingers at 3 feet (91.4 cm.) with the right eye and read ordinary print at arm's length with the left eye. The right pupil was dilated, the left of normal width; both reacted sluggishly to light and fairly in accommodation. The neck was rather stiff. The knee, elbow and wrist reflexes were relatively increased on the left side. Touch sense was normal, pain sense slightly impaired in the left leg.

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* Presented before the Chicago Neurological Society, Jan. 19, 1922.

* From the pathologic laboratories of the Cook County Hospital and Illinois State Psychopathic Institute.

Lumbar puncture yielded a clear fluid with negative Wasserman, Ross-Jones and Lange gold tests and a cell count of 5. The Wassermann test with the blood was also negative. Heart and lungs were normal.

Examination.—July 16: The pupils were rather wide and equal. The sense of smell was preserved on both sides. A watch was heard at 5 inches (12.7 cm.) on the right, not on contact on the left. There was no definite facial palsy. The patient could not raise his head from the pillow; attempted passive flexion of the neck caused pain, but there was no resistance to rotation. Shrugging of the shoulders and arm movements were very strong, but he could not raise himself to a sitting posture without the aid of his arms. The bladder was greatly distended. Abdominal reflexes were not obtained. Elbow and knee reflexes were brisk; ankle reflexes were normal. The patient had difficulty in placing the heel on the opposite knee, more on account of weakness than ataxia. He had to be catheterized in the evening but voided the next day.

Course of Disease.—July 18: Roentgenologic examination of the head: "Definite evidence of digital impressions in the anterior portions of the skull, also suggested in the parietal and temporal regions. The anterior and posterior clinoid processes appeared to be fused. Sella very small."

July 18: Leukocytes, 20,800. The temperature since admission had varied between 97.2 and 99.4 F.; the pulse between 72 and 92; respiration, 18.

July 19: Vision: With the right eye he counted fingers at 6 feet (1.82 meters); with the left eye, at 15 feet (4.56 meters). The fields were slightly contracted. Pupillary reaction to light was sluggish, more so on the right. The media was clear and the fundi normal. No muscular paralysis was present. Spontaneous nystagmus developed on deviation of the eyes in any direction. Hearing was present in both ears. Vestibular tests could not be made on account of the patient's weak condition.

July 24: Urination was frequent and burning, and there were many leukocytes in the urine. The neck was stiff as before. The left pupil was slightly larger than the right. The grip of the left hand was weaker than that of the right hand.

July 25: The patient was more somnolent. The reflexes varied from hour to hour, particularly the knee jerks. The left pupil and palpebral fissure were larger than the right. He was somewhat irrational. Slight internal strabismus and facial palsy on the left were present.

July 27: The patient had an attack of Cheyne-Stokes breathing during which the pulse became imperceptible.

The temperature did not exceed 100 F. until July 28, when it rose quickly from 99 to 104.8 F. before death on July 30.

Diagnosis.—No definite clinical diagnosis was made. Among the conditions most seriously considered were tumor or inflammation of the hypophysis, frontal lobe abscesses and some form of encephalitis.

Clinical and Gross Necropsy Findings.—These findings were: an acute infection followed by headache, vertigo, failing vision and urinary distress with retention. The somewhat indefinite neurologic findings were: unequal, sluggish pupils, slight rigidity of the neck, inconstant reflexes which varied from hour to hour, slight facial paralysis, strabismus and nystagmus. The course was acute and afebrile (except for terminal hyperpyrexia) and resulted in death seven weeks after the onset.

At necropsy the anatomic diagnosis by Dr. B. O. Raulston was: extensive right bronchopneumonia; acute right fibrinous pleuritis; encephalitis; edema of the meninges and brain; anemia and emaciation; moderate atheromatous changes of the aorta; fatty changes of the liver; narrowed cortices of the suprarenal glands; moderate hypertrophy of the spleen; fibrous adhesions between the spleen and the omentum, the vermiform appendix and the mesentery of the cecum; petechial hemorrhages in the gastric and duodenal mucosa, the renal pelvis and urinary bladder; acute hyperplasia and partial calcification of the tracheobronchial lymph glands; small accessory spleen.

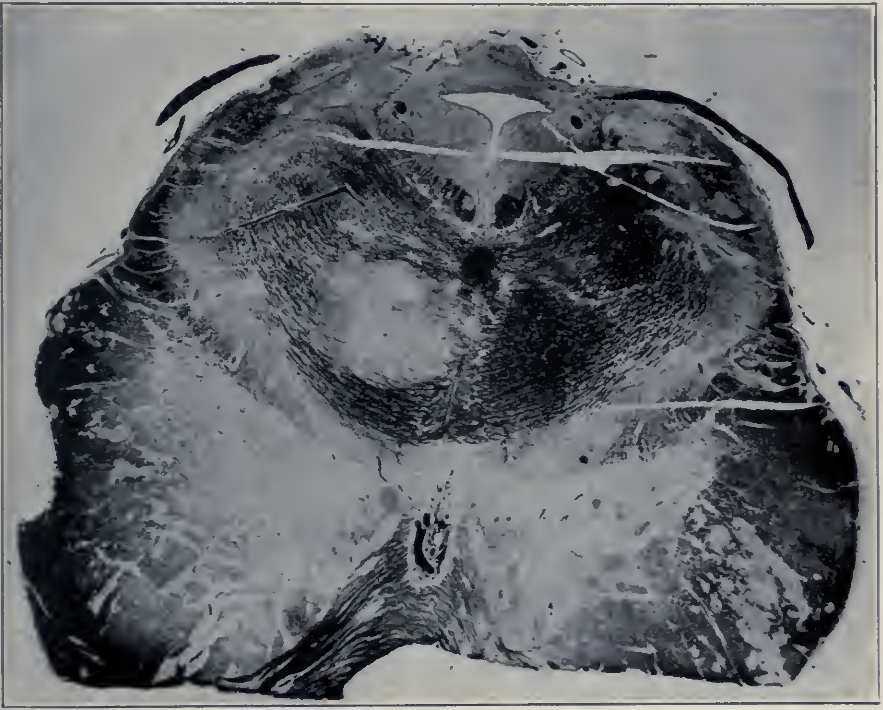

Fig. 1.—Soft patch in the decussation of the brachia conjunctiva. Weigert-Pal stain; × 4.

Histopathologic Examination (Dr. Hassin)

The brain, received in 10 per cent. formaldehyd, had been cut into small pieces. Macroscopically these appeared entirely normal, there being no evidence of hemorrhage, abscess, focal softening, meningeal or ventricular change.

After embedding in celloidin and staining with various methods, distinct patches were discovered in the medulla oblongata, pons, corpora quadrigemina, nucleus dentatus cerebelli and nucleus caudatus. Figure 1 shows such a patch in the pons where it occupied the left half of the decussation of the brachia conjunctiva. It appeared pale, round and sharply defined, greatly resembling a patch of multiple sclerosis.

Histologic examination, however, revealed marked differences. Figure 2 shows such a patch stained with toluidin blue. It consisted of a mass of cellular elements of exclusively gliogenous origin (myelophages and various types of gitter cells). Under a higher power (Fig. 3) they appeared markedly vacuolated and, in specimens stained with scarlet red, were seen to be filled with fat. The areas at the margin of the patches contained large cytoplasmic glia cells with numerous ramifying processes and an eccentric nucleus, rich in chromatin. There were many blood vessels, mostly small capillaries, distended with blood and possessing somewhat thickened walls with prominent and well stained endothelium and dilated adventitial spaces packed with gitter cells. Nerve fibers, fragments of myelin, Marchi globules and ganglion cells could not be found in the foci. Briefly, certain portions of the brain had been transformed into glia cells laden with lipoid substances, a phenomenon typical of secondary nerve degeneration.

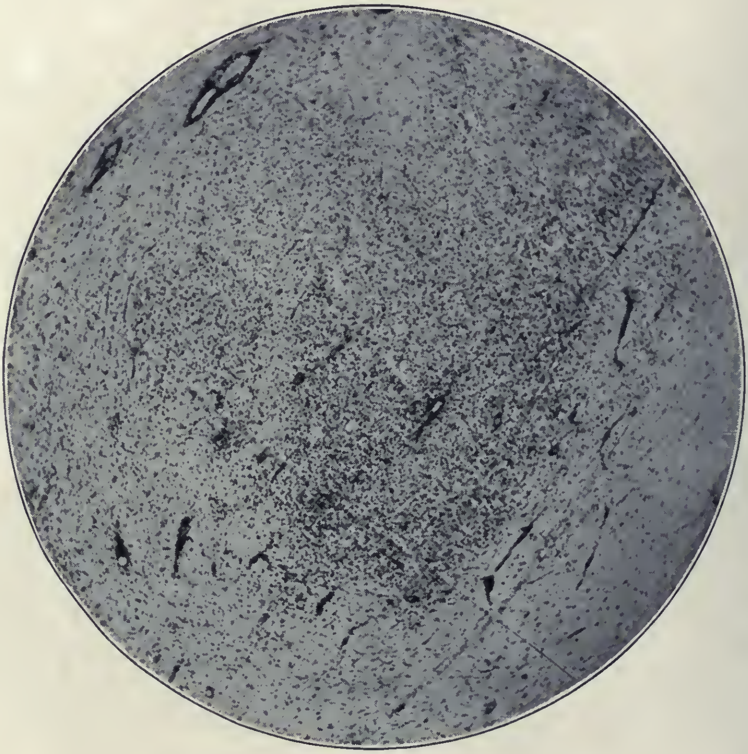

Fig. 2.—Soft patch in the region of the nucleus dentatus cerebelli, consisting of a mass of cell bodies represented under a higher power lens in Figure 3. Within the patch and surrounding the same are numerous small vessels and capillaries infiltrated with gitter cells. Toluidin blue; × 40.

Other areas were noteworthy, not so much for foci of degeneration as for the presence of a great wealth of blood vessels. Thus, the cerebral peduncles, the substantia nigra, the areas around the third and fourth ventricles and the medulla, all showed markedly infiltrated blood vessels (Fig. 4). At first glance they strikingly resembled the vascular condition seen in epidemic encephalitis; but when stained by the methods of Alzheimer-Mann, Bielschowsky and Herxheimer, the infiltrating elements proved to be principally gitter cells (Fig. 5). While in smaller vessels (Fig. 6) and capillaries these were the only types of cell found, in the adventitial spaces of larger vessels the gitter cells were intermingled with cells resembling lymphocytes. They were, however, homogeneous in appearance, pyknotic, without chromatin or cytoplasm. Cells indefinitely resembling plasma cells were also present but less common. In other words, while neither plasma cells nor lymphocytes could be recognized with certainty, their presence could not be excluded.

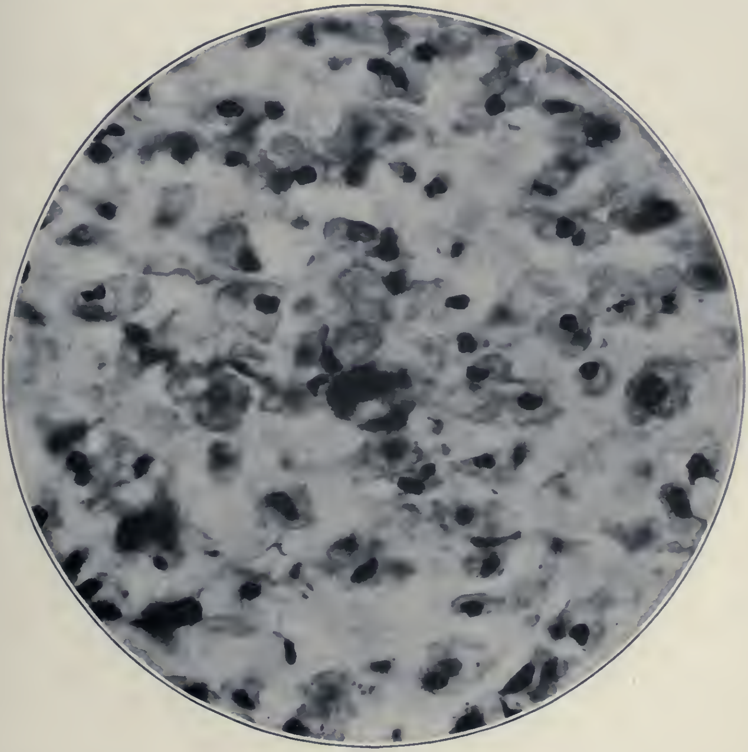

Fig. 3.—Same as Figure 2. Myelophages (large vacuolated bodies) and gitter cells. Use hand lens. Toluidin blue; × 490.

Some blood vessels and capillaries appeared quite normal, that is to say, without perivascular infiltrations, while in other rare instances there were indications of young and new-formed capillaries.

The ganglion cells, in the neighborhood of the foci, were more or less changed. The majority contained pale, chromatin-poor nuclei (as if undergoing dissolution or karolysis) and were provided with thick, tortuous, densely stained processes. Some cell bodies were somewhat swollen, or broken up and invaded by glia cells (neuronophagia). Others were distinctly vacuolated or sclerosed and shrunken with flattened nucleus, while the majority were packed with fat. In other words, karyolysis, neuronophagia and fatty cell degeneration were the prominent phenomena in the areas of the brain containing the foci of degenerative softening.

Equally pronounced were the changes in the basal ganglions (optic thalamus and nucleus lenticularis), the subcortical white substance, the cerebral cortex, cerebellum and especially the optic chiasm. These regions contained no patches but exhibited instead, especially in the neighborhood of blood vessels, numerous foci or clusters of glia nuclei (Fig. 7). The majority were of large size, rich in chromatin, and for the most part had a generous amount of cytoplasm. On the other hand, some glia nuclei, though somewhat large in size, were rather poor in chromatin and appeared pale and quite devoid of cytoplasm. The cytoplasmic glia cells frequently merged to form rosettes (Fig 8). These were quite frequent around or within the fat laden ganglion cells (Fig. 8).

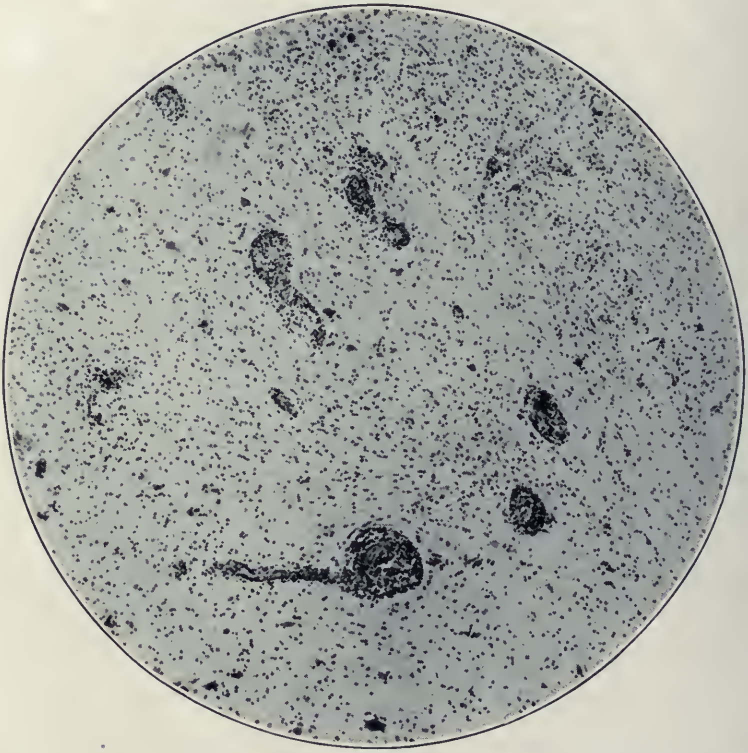

Fig. 4.—The region of the cerebral peduncles. Marked infiltration of blood vessels and capillaries resembling that seen in lethargic encephalitis. Some of the infiltration cells are reproduced in Figures 5 and 6. Use lens. Toluidin blue; × 70.

An interesting feature was the presence of rod cells (Stäbchenzellen) in the form of curved, sausage-like cell bodies supplied at their poles with slender processes. They were found not only in the cortex, but also in the subcortical areas and in the basal ganglions (Fig. 8). These regions were richly supplied with blood vessels, mostly capillaries, having lipoids in their perivascular spaces, but without other pathologic changes (thrombi, endarteritis, hyaline degeneration).

The nerve cells of the cortex and the basal ganglions showed changes which were somewhat similar to those already outlined. Especially noteworthy were accumulations of fat in the cell bodies (Fig. 9) and satellitosis in the form of rosette formation. Such cell changes involved every lobe of the brain, as well as every layer, though the deeper cortical strata were particularly affected.

Fatlike substances were also present in the glia cells and the capillary walls, and sections stained with scarlet red presented appearances characteristic of parenchymatous degeneration, well shown in Figure 10.

Lipoids were equally common in the pia-arachnoid all over the cortex and were mixed with a great number of lymphocytes, polyblasts, fibroblasts, and mesothelial cells. All these elements were scattered within the distended meshes of the subarachnoid space and the capsule of the pituitary body. The choroid plexus likewise showed drops or droplets of fatlike substances, especially within the tuft cells.

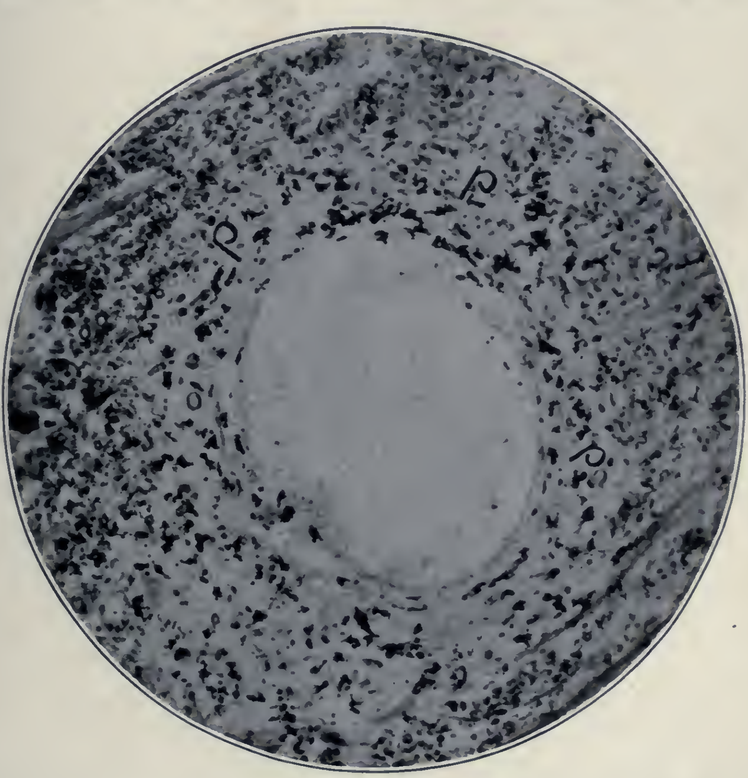

Fig. 5.—Nucleus caudatus: large vein infiltrated with fat granule cells—black stained cell bodies in the perivascular space, *p, p, p*. Herxheimer scarlet red; × 150.

Only the upper portion of the cervical region of the spinal cord was available for study. It showed no signs of secondary degeneration. The changes were similar to those found in the cortex: absence of large degenerative foci, presence of foci of glia nuclei, ganglion cell degeneration and absence of definite inflammatory phenomena.

The microscopic examination of the viscera and the pituitary body revealed no findings of special interest.

SUMMARY OF THE PATHOLOGIC FINDINGS AND DISCUSSION

The pathologic findings were:

1. Foci of degeneration in the midbrain, medulla and to a less extent in the nucleus caudatus.

2. Diffuse degeneration of the cortex, basal ganglions and the available portion of the spinal cord (cervical region).

3. Definite widespread gitter cell infiltration of the blood vessels, especially the capillaries, of the midbrain, basal ganglions and medulla.

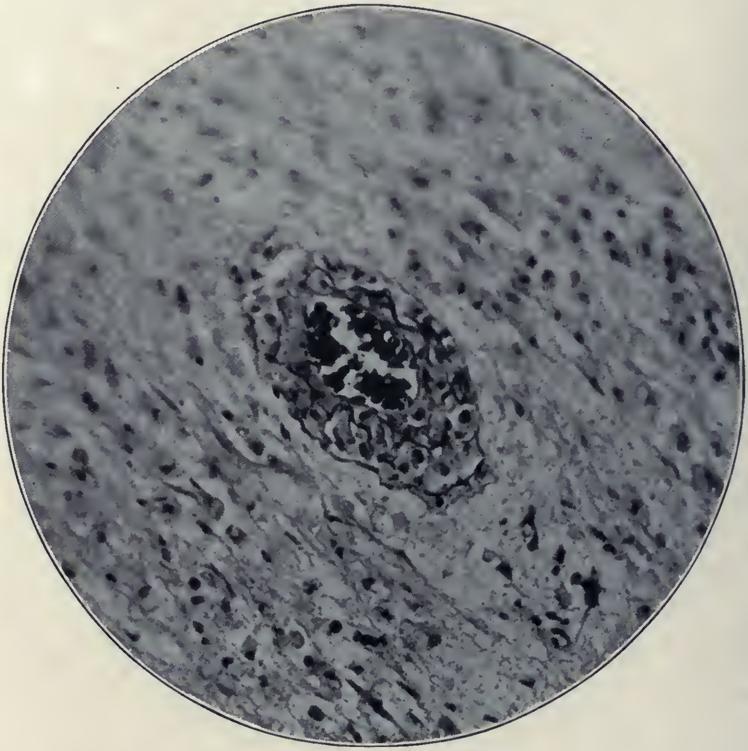

Fig. 6.—Optic chiasm: small blood vessel with numerous gitter cells in the distended meshes of the adventitial space. Bielschowsky stain; × 275.

4. Absence of inflammatory phenomena as well as of secondary degeneration in the spinal cord.

5. Reactive phenomena and presence of lipoids in the subarachnoid space and the choroid plexus.

Of the features described, the most outstanding were the patches of degeneration. As noted, grossly they resembled those of multiple sclerosis, but microscopically they differed greatly. Thus, nerve fibers, glia fibers and Marchi globules were entirely lacking, and the changes peculiar to the various stages of the evolution of a patch of multiple sclerosis were absent. The resemblance to the so-called second stage of such a patch, pointed out in a previous article,[1] is certainly superficial. For even in this stage of multiple sclerosis there are present, not only gitter cells and similar structures, but also nerve fibers, either well preserved, or in an early stage of degeneration. The foci in the case here described were entirely devoid of nerve structures and in this respect resembled foci of ischemic softening. They differed from these, however, in that the general architecture of the component elements was preserved as it is not in ischemic foci of softening such as those caused by thrombosis. In the latter the parenchyma is entirely broken up. Under the microscope the field is strewn with fragmented nerve fibers, with immense numbers of myelophages and gitter cells, many of which are crowded densely around or within the adventitial spaces of floating blood vessels. In short, the parenchyma is liquefied. The patches in this case did not show liquefaction. They were comparatively solid though much less firm than patches containing neuroglia or connective tissue. Compared with the latter, they were essentially soft, and it is in this sense that the term "softening" has been used.

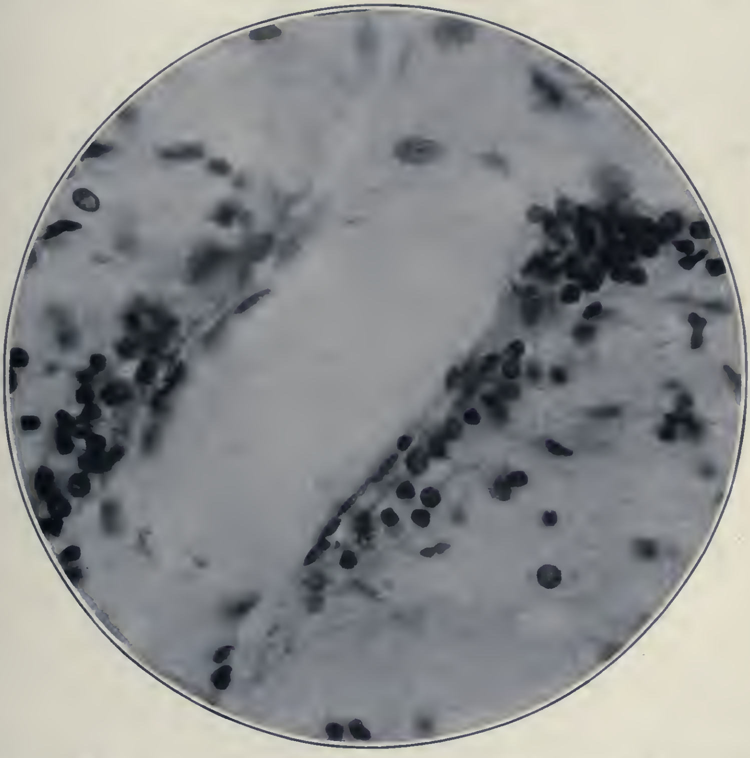

Fig. 7.—Motor area: Clusters or foci of glia nuclei around a large blood vessel. Toluidin blue; × 560.

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[1] Hassin, G. B.: Studies in the Pathogenesis of Multiple Sclerosis, Arch. Neurol. & Psychiat. **7**:589 (May) 1922.

In some respects they resemble the patches described by Williamson [1a] in a case of "early disseminated sclerosis."

The patient, a young man, 23 years old, complained of paresthesias in the hands and toes followed by a successive paralysis of the upper and lower extremities. The tendon reflexes were exaggerated, with bilateral foot clonus, while the skin reflexes were absent. There was intention tremor in the hands, scanning speech and nystagmus on looking to the right; the mentality was dull. Death occurred a year after the onset of the first symptoms. Necropsy revealed "soft roundish grayish-yellow gelatinous semitransparent patches" in the frontal lobe, in the center of the white substance of the left occipital and right temporosphenoidal lobes. In addition, there were found a number of "firm" patches in the white matter of the cerebral hemispheres, spinal cord, crus, pons and medulla. These consisted of dense neuroglia fibers, but showed no nerve fibers. The soft patches likewise were

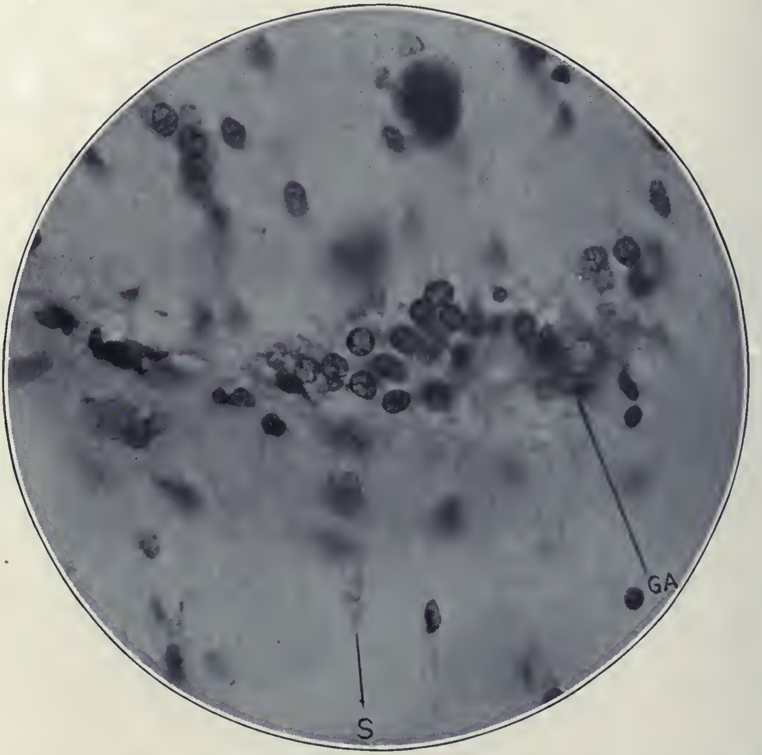

Fig. 8.—Optic thalamus: In the center accumulation of glia cells forming a rosette; *Ga,* ganglion cell invaded by glia cells (neuronophagia); *S,* Stäbchenzelle (rod cells). Use hand lens. Toluidin blue; × 560.

[1a] Williamson, R. T.: The Early Pathologic Changes in Disseminated Sclerosis, The Medical Chronicle **19**:373 (March) 1894.

devoid of nerve fibers and consisted of numerous "fat-granular bodies," white and red blood cells, "scattered neuroglia" fibers and glia cells and numerous dilated vessels infiltrated with "round" cells. From Williamson's description of the "soft" patches one may gather that they were not typical of anything seen in multiple sclerosis and that in some features they resembled the patches of our case.

The latter much more closely resembles the cases of Oppenheim and Henneberg,[2] Kramer and Henneberg,[3] Redlich,[4] Schultze,[5] a case described by one of us [6] and partly the case of Alzheimer.[7]

Oppenheim and Henneberg's patient was a man, 39 years old, with a history of trauma (contusion of the back). The clinical symptoms were: Korsakoff's syndrome, slight optic neuritis, hypotonia, loss of tendon and abdominal reflexes, bilateral Babinski sign (in spite of the paralysis being flaccid), bulbar symptoms (dysarthria, dysphagia, chewing troubles), facial nerve paralysis and urinary disturbances. The remarkable feature was the variation of the reflexes, as in our case, and the hypotonia. Oppenheim concluded that the case was either acute multiple sclerosis or disseminated encephalomyelitis.

The histopathologic examination by Henneberg showed foci of softening in the corpus callosum, the adjacent hemispheres and cingulum. In the "distal portion of the pons and medulla" there was a large focus which microscopically looked like an "infiltrative encephalitis." The cerebral foci showed no axons, but many fat granule bodies enclosed within meshes of "connective tissue," large glia nuclei and small cell infiltration of some larger blood vessels. The spinal cord exhibited diffuse degenerative and inflammatory changes. Henneberg ascribes the foci in the brain to an "inflammatory softening" probably due to stasis, while those of the pons and medulla though resembling, he says, "malignant" multiple sclerosis, are rather "indicative of acute degenerative encephalitis."

Though Henneberg's conceptions of so-called degenerative encephalitis (and degenerative or funicular myelitis) are open to criticism, his views as to the nature of the so-called degenerative (funicular) myelitis being by no means universally accepted, he certainly was justified in rejecting Oppenheim's diagnosis of multiple sclerosis. The cellular infiltrations which he mentions, but does not describe, might have been fat-granule bodies (gitter cells), and the process thus wholly degenerative.

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[2] Henneberg: Ueber disseminierte Encephalitis, Neurol. Centralbl. **36**:652, 1916. Oppenheim: Deutsch. Ztschr. f. Nervenh. **52**:172, 1914 (Case 1).

[3] Kramer and Henneberg: Ueber disseminierte Encephalitis, Neurol. Centralbl. **36**:984, 1916.

[4] Redlich, E.: Ueber Encephalitis Pontis et Cerebelli, Ztschr. f. d. gesam. Neurol. u. Psychiat. (Originalien) **37**:1, 1917.

[5] Schultze, F.: Ueber Multiple Sclerose und herdförmige Encephalitis, Deutsch. Ztschr. f. Nervenh. **65**:1, 1920.

[6] Hassin, G. B.: Histopathologic Findings in a Case of Superior and Inferior Poliencephalitis with Remarks on the Cerebrospinal Fluid, Arch. Neurol. & Psychiat. **5**:552 (May) 1921.

[7] Alzheimer: Ueber eine eigenartige Erkrankung des Zentralnervensystems mit bulbären Symptomen und schmerzhaften spastischen Krampfzuständen der Extremitäten, Ztschr. f. d. gesam. Neurol. u. Psychiat. **33**:45, 1916.

Kramer-Henneberg's case concerned a woman, 43 years old, who gradually developed left hemiplegia and hemianesthesia, preceded by asthenia, paresthesias, first in the left hand and then in the entire left side of the body, and diminution of taste in the left half of the tongue. All these symptoms, except slight weakness in the left hand, cleared up.

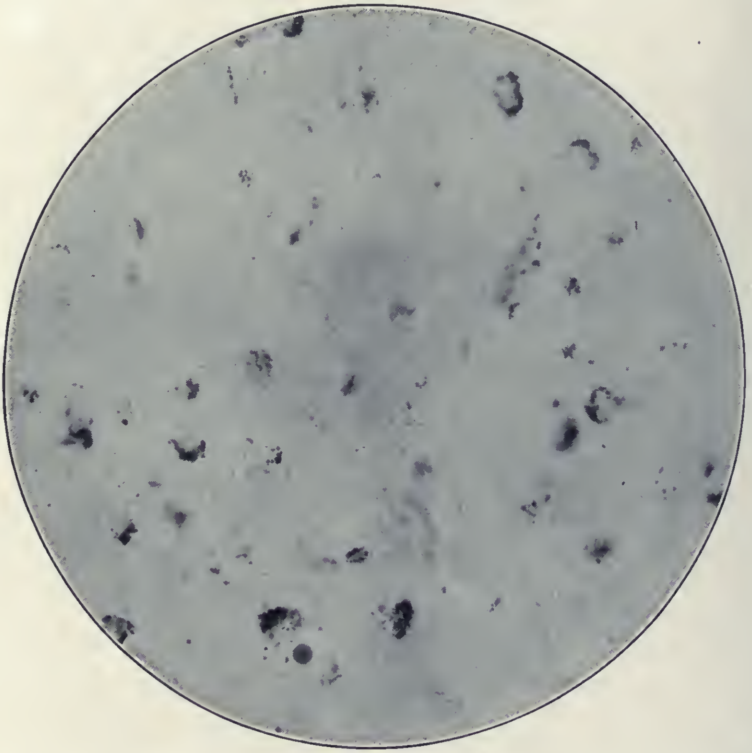

Fig. 9.—Putamen: lipoids in the ganglion cells can be distinctly seen, especially with the help of a hand lens. Scarlet red; × 275.

Three years later, the left hemiplegia and hemianesthesia returned, together with paralysis of the right sixth and seventh cranial nerves and diminution of hearing and taste on the right side. These symptoms were followed by disturbances of deglutition and speech, strabismus and diplopia. The duration of the second attack was about three months.

Necropsy revealed a focus of softening in the right hemisphere. It involved the posterior central convolution, gyrus cinguli and corpus callosum, extending to the white substance. Another focus existed in the medulla oblongata occupying an area comprising a portion of the decussation of the pyramids, the middle of the pons, the sixth nucleus, brachia conjunctiva, mesial lemniscus and the reticular substance. Microscopically, there was no myelin, a few glia fibers and numerous gitter cells (in the medullary focus) mixed with rod cells; the vessels were infiltrated with lymphocytes which freely invaded the neighboring tissues. Henneberg is inclined to consider this case somewhat akin to malignant multiple sclerosis, but prefers to classify it as disseminated encephalomyelitis.

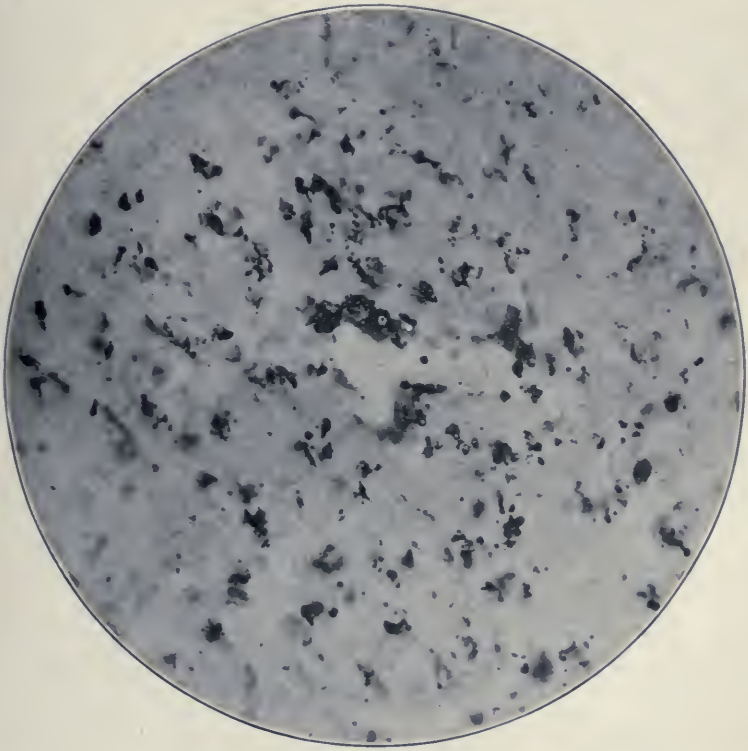

Fig. 10.—Cortex: lipoid substances in the ganglion cells, glia nuclei and around capillaries. Herxheimer scarlet red; × 230.

Redlich's patient, a young man, 20 years old, suddenly developed cerebellar ataxia, left ocular paralysis and nystagmus. Slight improvement was followed by paralysis of all the branches of the left, and then of the right, seventh nerve, ataxia in the right leg, increased tendon reflexes with bilateral Babinski sign and slight intention tremor. The duration of the illness was about five months. At necropsy there were found large foci of softening in both cerebellar hemispheres, extending through the posterior corpora quadrigemina into the pons, red nucleus and the decussation of the pyramids. The foci of the midbrain consisted of numerous fat-granule cells, proliferated glia cells and hyperemic blood vessels infiltrated "so far as could be made out" with lymphocytes, and, possibly, with plasma-cells. Notwithstanding the predominance of degenerative phenomena, Redlich considers this case an inflammatory process; he therefore excludes multiple sclerosis and designates it "subacute interstitial or hyperplastic encephalitis of Hayem."

Schultze's patient, 43 years old, had "aphasic-dysarthric" troubles, right hemiparesis with exaggerated reflexes but without Babinski sign, disturbed sense of position in the right fingers and an uncertain gait. The condition gradually became worse and within three weeks there was complete right-sided paralysis with exaggerated reflexes and positive Babinski sign on both sides, marked disturbances of speech, deglutition and urination and mental depression. The patient had previously had two transient attacks of paralysis of the left arm, one about a year, the other about fourteen years, prior to the onset of the last illness which lasted altogether about ten weeks. Necropsy revealed numerous miliary foci in the left hemisphere (cortical and subcortical), pons and medulla, while the spinal cord appeared normal throughout. The foci contained no myelin, hardly any axons, many gitter cells and no infiltrated vessels. Neither clinically nor pathologically was the case clear to Schultze. He considered multiple sclerosis, encephalitis, "focal tissue destruction" and, as he put it, "probably an entirely new not yet described clinical entity." At any rate, he adds, it was not an inflammatory process.

In a case reported by one of us,[6] the clinical picture was a combination of poliencephalitis superior (ophthalmoplegia) with bulbar paralysis (poliencephalitis inferior). Histologically, there were extensive foci of degeneration in the medulla, pons and midbrain, combined with diffuse degeneration of the cortex and basal ganglions.

Quite unique was Alzheimer's case. A woman, 27 years old, showed mental disorder (depression and impulsive crying) with disturbances of speech, deglutition and gait. A remarkable feature was the occurrence of attacks of painful tonic muscular contractions in the left arm which would set in on attempts to talk. The muscles of the entire left arm, except those of the fingers would become hard as wood and very painful. The painful spasmodic contractions then involved the right arm and the left leg, and to prevent such attacks the patient had to avoid talking. Death occurred about three years after the onset.

Necropsy revealed combined cord degeneration, symmetrical foci of degeneration in the seventh cranial nerve nuclei and nucleus ambigus, in the globus pallidus (bilaterally), foci of glia nuclei (rosettes) and numerous "focal" changes in the subcortical white substance. Alzheimer was at a loss to classify the condition, which he says was unlike anything so far described. He was inclined to consider it as an atypical Wilson's disease.

A number of other cases are reported which most likely belong with the foregoing types, that is to say, in which the degenerative phenomena predominated. Unfortunately, the microscopic descriptions are so indefinite and inconclusive that these cases cannot be used.

Even in the cases quoted, the histopathologic studies, except those of Alzheimer, are rather superficial and confined to the foci. The remainder of the brain was either neglected altogether or studied partially. It is therefore impossible to ascertain whether the focal lesions were associated with a diffuse process observed in our case.

On the other hand, a few cases have been described in which the morbid process was diffuse only and resembled that found in the cortex and the basal ganglions in our case. Here belong the cases of Creutzfeldt,[8] Jacob[9] and Economo-Schilder,[10] though the last one presents somewhat different aspects. The principal microscopic findings in these excellently studied cases were:

1. Ganglion cell degeneration with accumulation of lipoids.
2. Foci of glia cells with rosette formation.
3. Presence of lipoids in the perivascular spaces of the blood vessels.
4. Foci of destruction in the cortical layers.
5. Hypertrophied glia nuclei.
6. Total absence of inflammatory phenomena, with the occasional presence of rod cells (Stäbchenzellen).

While Economo and Schilder consider their case one of pseudosclerosis, Creutzfeldt and Jacob consider their own cases and that of Alzheimer as instances of a peculiar pathologic entity not previously described. Jacob even attempted to construct a separate clinical syndrome in accordance with the pathologic findings. Though it might be expected that diffuse, like focal, brain degenerations should give more or less characteristic clinical pictures, they must of necessity be exceedingly polymorphous and indefinite. Much will depend on the number of foci, their size and location. The morbid process, for instance, may principally affect either the medulla, pons and midbrain (as in our case), or the large ganglions (as in Alzheimer's case) and give corresponding more or less characteristic symptoms. In addition, the clinical picture will be influenced by the extent of the associated diffuse lesions.

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[8] Creutzfeldt, G.: Ueber eine eigenartige herdförmige Erkrankung des Zentralnervensystems, Ztschr. f. d. gesam. Neurol. u. Psychiat. **57**: 1, 1920.

[9] Jacob, A.: Ueber eigenartige Erkrankungen des Zentralnervensystems mit bemerkenswertem anatomischen Befund, Ztschr. f. d. ges. Neurol. u. Psychiat. **64**: 147, 1921; Med. Klinik., 1921, No. 13 (4th case).

[10] Economo, C., and Schilder, P.: Eine der Pseudosclerose nahestehende Erkrankung im Praesinium, Ztschr. f. d. gesam. Neurol. u. Psychiat. **55**: 1, 1920.

This remarkable association of focal and diffuse degenerative lesions is analagous to phenomena observed in certain inflammatory disorders. Thus in epidemic encephalitis a focal midbrain inflammation is associated with more or less diffuse inflammatory phenomena, while in the present case a focal midbrain degeneration is associated with diffuse degenerative changes. The latter may coexist with slight inflammatory phenomena which, however, in our case, were so indefinite and so uncertain that they may be entirely disregarded. At any rate, it would be illogical to consider the case one of inflammation, in the presence of such intensive and extensive signs of degeneration. While resembling histologically such clinically well defined chronic degenerative diseases as the lenticular degeneration of Wilson, combined cord degeneration, amyotrophic lateral sclerosis, multiple sclerosis and similar essentially *chronic* states, the group under discussion comprises essentially *acute* degenerative states in which the clinical features are obscure, variable and difficult of interpretation.

It is therefore highly probable that, as noted, some indefinite clinical syndromes recorded as acute or "malignant" multiple sclerosis, degenerative encephalitis and disseminated encephalomyelitis, form a separate morbid entity.

For this the name "multiple degenerative softening" would seem to be the most suitable.

CONCLUSIONS

1. Besides a vast group of acute inflammatory brain lesions, there is an equally large group of acute degenerative brain lesions.

2. The latter present most varied and indefinite clinical syndromes variously described as acute multiple sclerosis, malignant multiple sclerosis, degenerative encephalitis, etc.

3. The inflammatory and the degenerative types resemble one another in the localization of the morbid process, some portions of the brain being affected more, others less.

4. The most conspicuous pathologic features of the acute degenerative type are soft patches which grossly resemble the firm patches of multiple sclerosis, but which microscopically have a definitely different structure.

5. The soft patches are associated with a diffuse degeneration of the brain substance.

6. In view of the specificity of the histologic features of the patches it would be proper to collect the acute degenerative states into a separate morbid group, under the name of "multiple degenerative softening."

THE MENTAL SYMPTOMS OF MULTIPLE SCLEROSIS *

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The mental symptoms of multiple sclerosis are of several types, and different writers stress different symptoms. Some describe the euphoric cases, others cases accompanied by dementia, while still others center their attention on the occasional episodes of depression, the delusions and hallucinations. A cursory view of the subject shows that in multiple sclerosis there is not a consistent group of symptoms.

We are quite unprepared to state the incidence of mental symptoms in multiple sclerosis. However, including euphoria, probably in 90 per cent. of cases there are mental alterations which warrant the term "mental symptoms." Because they are overshadowed by physical symptoms and are so often of a character to introduce no element of alarm, they are frequently disregarded. Then, too, the physical condition makes the patient inapt in all his physical undertakings and renders him psychiatrically nonpotential, even in those instances in which unhampered psychotic tendencies would otherwise bring different results. Generally speaking, the patient with multiple sclerosis cannot carry out the things which might lead to committment. Hence it is not surprising that there were only three cases of multiple sclerosis among the 6,700 insane patients in the Manhattan State Hospital.

We have not been able to demonstrate any predisposition to mental disease in these patients; the mental symptoms seem more dependent on the organic brain disease than on an underlying tendency.

EUPHORIA

Many patients with multiple sclerosis have a slight elevation of mood which may be termed euphoria. Although suffering from a serious disease, they do not think of their condition as serious, nor do they seem deeply concerned about it. In the great majority of cases it does not amount to a psychosis; it is simply a marked inconsistency between the patient's mood and his physical disability. The following case is illustrative:

A woman, 31 years of age, has had symptoms of multiple sclerosis for over ten years and has been in the Montefiore Home for three years. The case is an advanced one. She cannot walk; is nearly blind; her speech is so indistinct that she can scarcely make herself understood; she is so ataxic that she has

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* Read before the Association for Research in Nervous and Mental Diseases, Dec. 29, 1921.

to be fed. Despite the almost complete helplessness, she is optimistic and cheerful, laughs and jokes about her symptoms and is not in the least concerned about her condition. Neither is she demented. She can give a full and accurate account of her past life. This euphoria is the only mental symptom.

If euphoria were seen in only one case it might be regarded as individual, depending on the personality of the patient. But it is so frequent that it must be regarded as a mental change associated with multiple sclerosis. It was seen in ten of the fourteen patients showing mental symptoms whom we examined. The euphoria may become much more marked; a manic-like state may result.

Patients in a few cases described in the literature had delusions of grandeur similar to those seen in patients with paresis. This generally occurs as a terminal state associated with considerable dementia. But even these terminal cases do not, as a rule, show the silly euphoria nor the marked change in personality of the paretic. The cause of the euphoric state in multiple sclerosis is not known. The euphoria of paresis and the facetiousness often noted in brain tumor are also not clearly explained.

STATES OF MENTAL DEPRESSION

Patients with multiple sclerosis have developed suicidal ideas and have attempted suicide. We give an illustrative case:

In a man, aged 28, symptoms were noted four years ago. When he became incapacitated because of his disease he became depressed and attempted to commit suicide with a razor. He was sent to Bellevue Hospital and then to Ward's Island, where he gradually grew worse and was tube-fed over a long period. He attacked other patients without provocation. At present he is irritable, but has grown somewhat euphoric. Although bedridden he thinks he could earn his own way if he left the hospital. His judgment is very poor, but no defects of memory can be determined.

This depressed type of mental disturbance is occasionally seen in multiple sclerosis, but in our experience it is not accompanied by great slowing or retardation. It is probably a mental reaction to the serious condition in which patients find themselves; but even in these cases euphoria tends to develop as the disease progresses.

MENTAL DETERIORATION

It might be expected that in a progressive organic brain disease such as multiple sclerosis, marked mental deterioration would occur in all patients. This is not the case. Often even in advanced cases, changes of this character are slight or amount only to a chronic mental tension defect. On the other hand, occasionally serious deterioration is seen.

A patient in the Manhattan State Hospital is feeble, partially bedridden, and has greatly impaired vision. His memory is defective. Although he sees the physician from time to time he never recognizes him as the same man and once he thought that the physician was a relative. He cannot distinguish dinner from supper or recall when he has had his meals and when he has not. His judgment is very poor, and he says that he is staying in the hospital to kill time. His mood is one of unnatural complacency. Before he was committed to the hospital he spoke of hearing women's voices talking to him on the street. He imagined that there was some plot against him though he was not insistent about it and when mental deterioration began this trend disappeared.

His family history is so remarkable and so unlike that usually found in multiple sclerosis that it needs special comment. His brother died at the age of 31 of multiple sclerosis with mental symptoms. The diagnosis was confirmed at necropsy. His sister is now in the Central Islip State Hospital, with a case diagnosed as multiple sclerosis, and she also has a psychosis.

Deterioration, in brief, may or may not occur, though probably it is present in a majority of all cases; its degree of progress varies in different patients, only occasionally becoming profound; and as would be expected, as it develops it obliterates, to a large degree, tendencies which may have been present. Some patients have only a mild disturbance of memory, of which they are entirely aware. In a few reported cases there have been Korsakoff-like pictures, but we have found no such cases and feel that this type is rare.

HALLUCINATIONS

Auditory hallucinations without insight and occurring as a feature of a delusional trend are not unusual. The case mentioned in the foregoing is a typical instance of this.

We have to report a single example of considerably more bizarre hallucinatory phenomena in a case observed at the Neurological Institute:

A young woman, 31 years of age, whose physical symptoms have existed for two and one-half years, for many months has had visual hallucinations: To her the rug appears to be on fire and smoke issues from the carpet. She has seemed to see bright green beetles crawling on the window-pane. Occasionally she has seen people approach the door and she has not known definitely, until reassured, that no one was there. The remarkable feature is that she has perfect insight into these experiences. She cannot be said to be suffering from a psychosis, and she realizes that these false impressions are caused by her disease.

On one or two occasions she has had hallucinations of hearing, such as a band playing or voices singing. There are no hallucinations of taste, touch or smell. Examination of the eyes revealed 20/50 vision in the right eye; 20/70 in the left eye, with temporal pallor of the optic disks and some contraction of the visual fields.

The character of the hallucinations suggests that they arise on some irritative or toxic basis either in the higher visual centers or in the pathways leading to them.

TRENDS

Cases are occasionally seen which bear a certain resemblance to dementia praecox, of which the following is an example:

In a woman, aged 35 years, severe mental symptoms began after the disease had existed for nine years. Although she was entirely blind at that time, she thought that people were watching her, that they came into her room at night, and that they were threatening to kill her. She spoke of hearing voices. Much of her thought content had to do with sex affairs. She thought that men were paying her attention with the idea of marriage.

Although bedridden and entirely helpless she still talks about the possibility of marriage. However, these paranoid trends have almost entirely disappeared, and now she is mildly euphoric or at least contented and happy.

In this case the delusional trend and hallucinations may be less directly dependent on an organic lesion and appear to be of a more dementia-praecox-like nature. In none of our cases have we found negativistic phenomena or catatonic reactions.

PERSONALITY

Apart from certain mood changes, for example euphoria, patients with multiple sclerosis usually retain the same personality that they had before their illness. Even though there is deterioration, they do not as a rule show marked moral and ethical changes, and there is comparatively little of the grave disturbance of personality common in paresis. In this domain it is reported that those cases have resembled paresis most which at necropsy showed considerable lesions of the frontal lobes. However, even in such cases, personality changes were not great.

Careless use of terms has led some writers to talk of hysterical and neurasthenic reactions in the disease. We are struck by the absence of such features in the cases which we have studied.

COURSE OF MENTAL SYMPTOMS

An interesting characteristic of the mental symptoms in multiple sclerosis is their marked tendency toward change and tendency toward regression of certain of the phases, particularly the trends. Often the paranoid and delusional states are of only a few months' duration. The brevity of these states may be quite unexplainable. They may disappear as deterioration advances. With the subsidence of trends, there is a tendency for euphoria to increase, and grandiose elaboration may be a very late development.

CONCLUSIONS

Our observations lead us to divide the mental symptoms of multiple sclerosis into two groups: first, those which are primary and directly the result of the organic lesions; second, those which are incidental and secondary.

In the first group we would place euphoria, since it seems to be associated with the organic brain condition; likewise the mental defect symptoms, the occasional hallucinations of organic origin and the very rare confused states and Korsakoff's psychosis; also the occasional terminal states with delusions of grandeur.

In the second group we would place those transitory delusional states and depressions which appear to arise as a result of the condition of incapacity in which the patient finds himself. Here probably belong suicidal attempts and delusional trends accompanied by hallucinations often of only a few months' duration. There are still other delusional trends which are more like dementia praecox. However, marked distortion of thought and oddities of conduct which are so frequent in dementia praecox are not encountered in multiple sclerosis.

While multiple sclerosis has symptoms in common with other organic brain diseases, the mental symptoms do not closely resemble these conditions. The clinical picture is not that of paresis nor that of cerebral arteriosclerosis. The symptoms are more like those occasionally seen in brain tumor.

There is no correlation between the parts of the body showing the effects of the disease in greatest intensity and the content of delusional or hallucinatory trends.

It is reasonable to suppose that the secondary symptoms, such as depressed and paranoid states, depend to a considerable extent on the mental makeup of the patient before the disease developed; but with the primary mental symptoms of the disease this is not the case. Although the latter are quite variable, they are not more so than are the physical symptoms.

BIBLIOGRAPHY

Bassoe, P.: Report of a Case of Multiple Sclerosis with a Delusional State and Terminal Delirium. Necropsy, J. Nerv. & Ment. Dis. **45**:268-269, 1917.

Bechterew, W.: Ueber die Läsion der Hirnrinde bei der disseminirten Sklerose, Neurol. Centralbl. **21**:285, 1902.

Bourneville: Sclérose en plaques ayant debuté dans l'enfance; imbecilité. Progrès méd., Ser. 3, **11-12**:321-328, 1900.

Dannenberger: Zur Lehre von den Geistesstörungen bei multipler Sklerose, Inaug.-Diss., Giessen, 1901.

Dercum, F. X.: A Case of Multiple Spinal Sclerosis Presenting Unusual Symptoms Suggesting Paresis, J. A. M. A. **59**:1612-1613 (Nov. 2) 1912.

Euziere: Les troubles psychiques dans la sclérose en plaques. Arch. gén. de Méd., 1909, pp. 746-756.

Freund, C. S.: Psychische Störungen bei multipler Sklerose, Berl. klin. Wchnschr. **50**:1777-1778, 1913.

Gill, A. W.: Disseminated Sclerosis with Hysterical Symptoms of Seven Months' Duration; Symptoms Cured by Psychotherapy, Seale Hayne Neurol. Stud. **1**:277 (Aug.) 1919.

Hunt, J. R.: Multiple Sclerosis with Dementia. A Contribution to the Combination Form of Multiple Sclerosis and Dementia Paralytica, Am. J. M. Sc. **126**:974-985, 1903.

Kaplan, J. F.: Multiple Sclerosis with Psychical Signs, J. Nerv. & Ment. Dis. **31**:139-140, 1904.

Knoblauch, A.: Ein Fall von multipler Sklerose compliziert durch eine chronische Geistesstörung, Monatschr. f. Psychiat. u. Neurol. **24**:238-250, 1908.

Lannois, M.: Troubles psychiques dans un cas de sclérose en plaques, Rev. Neurol. **11**:876-881, 1903.

Maloney, W. J.: Disseminated Sclerosis, Proc. Roy. Soc. Med., Lond., Sect. Neurol. **3**:99, 1909-1910.

Nonne, M.: Klinischer und anatomischer Beitrag zur Kasuistik der Geistesstörung bei multipler Sklerose, Mitteil. a. d. Hamburg. Staats. Krank. **11**:199-212, 1910.

Nonne, M., et al.: Anatomische Untersuchung eines Falles von multipler Sklerose mit psychischen Störungen, Neurol. Centralbl. **29**:842-845, 1910.

Pitres, A., and Marchand, L.: Observations de syndromes commotionels simulant des affections organiques du systeme nerveux central, Rev. neurol. **23**:298-311, 1916.

Raymond and Touchard: Sclérose en plaques debutant par des troubles mentaux simulant la paralyse generale, Rev. neurol. **17**:224-228, 1909.

Redlich, E., and Economo, C.: Demonstration mikroskopischer Präparate eines Falles von multipler Sklerose mit psychose, Jahrb. f. Psychiat. **30**: 315-318, 1909.

Ross, D. M.: The Mental Symptoms in Disseminated Sclerosis, Rev. neurol. & Psychiat. **13**: No. 8, 1917.

Schultze, F.: Ueber die beziehungen der multiplen Sklerose des centralen Nervensystems zur allgemeinen progressiven Paralyse der Irren, Arch. f. Psychiat. **11**:216-229, 1881.

Seiffer: Ueber psychiche in besondere Intelligenzstörungen bei multipler Sklerose, Arch. f. Psychiat. **40**:253, 1905.

Uyematsu, S.: A Case of Diffuse Cerebrospinal Sclerosis, J. Nerv. & Ment. Dis. **51**:514-533, 1920.

Westphal, A.: Multiple Sklerose und Hysterie, Deutsch. med. Wchnschr. **32**: 403, 1906.

Abstracts from Current Literature

THREE CASES OF TUBERCULOUS MENINGITIS RESEMBLING EPIDEMIC CEREBROSPINAL MENINGITIS; RACHIDIAN POLYNUCLEOSIS. Riser and Roguer, Ann. de méd. **10**:10 (July) 1921.

This is a comprehensive article dealing with a comparatively uncommon clinical variety of meningeal tuberculosis, and the writers cite three illustrative cases.

In the course of tuberculous meningitis without superimposed infection, polynucleosis in the spinal fluid is not exceptional. This polynucleosis may be caused by an abundance of organisms, the nearby presence of an old caseous meningeal focus, or subacute evolution. But each of these causes taken alone cannot explain all the cases, and the pathogeny of the reaction is still not entirely established.

Bearing on this point, however, the writers report their own experiment in which they have injected tuberculous toxins, isolated by the D'Auclair method, in the subarachnoid space. One injection brought about a polynucleosis lasting from four to six days and repeated doses, at intervals, induced a permanent reaction. They then suggest that in tuberculous meningitis the spinal fluid polynucleosis may be due to the repeated liberations of toxins in the subarachnoid cavity.

The authors say that in the presence of a polynucleosis. without proof of the presence of the micro-organisms of an acute infection, the Koch bacilli should be searched for. In all doubtful cases antimeningococci serum should be injected because it is beneficial in epidemic meningitis and does not aggravate the prognosis in tuberculous meningitis.

SOME DETAILS OF TECHNIC IN SPINAL ANESTHESIA. Rene Dumas, Bull. Med. **36**:22 (Jan. 11) 1922.

This is an interesting defense of spinal anesthesia which, in the opinion of the author. has been left in comparative disrepute, chiefly owing to the omission of certain features of its proper administration.

A preliminary injection (subcutaneous) of morphin is indispensable (1 to 2 cg.) and should be given 45 minutes prior to the lumbar puncture. At the same time that the morphin is injected, the writer advocates the injection of 1 to 2 mg. of strychnin and 5 cg. of spartein. These drugs combat the onset of symptoms due either to bulbar intoxication or anemia.

For gastric surgery, the lumbar puncture and injection is given between the first and second lumbar vertebrae, for pelvic. between the second and third and for perineal between the third and fourth. If one makes the puncture between the first and second lumbar vertebrae, it is necessary to be careful not to prick the conus. It is probable that some of the reported cases of sphincter incontinence are due to such injury.

Remove 25 c.c. of spinal fluid or more, even 30 or 40 c.c. if that is necessary to reduce the flow of fluid to a slow drop by drop flow. It is well to draw off fluid to this extent because the subsequent diffusion of the analgesic liquid is thereby favored.

Cocain when injected gives a rapid and sure anesthesia but is "brutal" and should seldom be employed. Stovain, less toxic, gives a good anesthesia, but has not been proved that it does not effect an irritation of the pia mater and nerve cells. Procain is best, inasmuch as its action is rapid and toxicity feeble. The dose varies with the desired duration of anesthesia. The writer finds that 12 cg. of procain gives an hour of anesthesia for the entire abdomen. Eight centigrams suffice for the current operative procedures of pelvic surgery, with about 45 minutes of anesthesia. Five centigrams, for the anus and perineum, give the same duration.

The writer emphasizes the great importance of pure and properly sterilized drugs for the purpose.

Of the accidents of the procedure, retention of urine occurs in from 10 to 15 per cent. of the cases of abdominal intervention—the large dosage employed? It lasts from one to six days. Meningeal signs are exceptional and are treated by repeated lumbar punctures.

The principal contraindications for this method of anesthesia are all conditions of shock and of infection—such conditions as intestinal occlusion, strangulated hernia, peritonitis and grave hemorrhage. On the other hand, apart from shock and infection, "pelvic surgery is the triumph of spinal anaesthesia."

RADICULAR SCIATICA WITH REFLEX GLYCOSURIA AND SYMPATHETIC DISORDERS IN A TUBERCULOUS PERSON. NECROPSY CYST ON A LUMBAR ROOT. RADICULO-SYMPATHIC REFLEXES. Lortat-Jacob, Progrès méd. **36**:611 (Dec. 31) 1921.

This report concerns a case of advanced pulmonary tuberculosis in which severe unilateral root symptoms localized in the right leg complicated the clinical situation. For the last two years of life there were recurring sciatic attacks. During the late and severe recrudescences, there were striking vasomotor signs in addition to the absence of the right ankle reflex, muscular atrophy of the muscles supplied by the fourth lumbar root, anesthesia in the same radicular zone, and excruciating causalgic radicular pains with diffuse hyperesthesia. The clinical picture was further complicated by a glycosuria which the writer calls a reflex glycosuria "analogous to that which one obtains by irritation of the central end of the sciatic nerve." Under the influence of sedative treatments, including the epidural injection of procain on two occasions, the glycosuria disappeared, and this is considered further evidence of the reflex pathogeny of the metabolic disturbance.

Necropsy revealed, besides the expected lung lesions, a transparent cystic proliferation on the right fourth lumbar root.

Davis, New York.

LATE THERAPY OF NERVE WOUNDS. Theodor Mauss, Ztschr. f. d. ges. Neurol. u. Psychiat. **65**:36, 1921.

The treatment of old nerve injuries, Mauss considers under two heads: operations on the nerves themselves, and orthopedic measures. His article is full and well balanced, and summarizes the experience of German workers during the seven years since the beginning of the World War. There is nothing strikingly original reported; methods and statistics are to be found in articles by Foerster, Krueger, Stoffel and others. This is a general review of the situation. The most striking statements are those concerned with the time required for the regeneration of nerves.

The author devotes a few pages to the manifestations and theories of degeneration and regeneration, and gives these practical conclusions:

1. Regeneration of nerves is impossible unless the severed ends are joined.

2. Healing by primary intention with immediate return of function is impossible.

3. Possibility of regeneration is always present although in the course of years it becomes diminished. "We do not know 'too late' in nerve operations."

With these principles in mind, Mauss says that every patient with a severe lesion should be operated on.

Beginning with the simpler operations on nerves, the author believes that when the nerve is intact, surgical procedure should depend on the density of the scar, the ease with which the nerve is separated into fasciculi either by hand or by intraneural injection of saline, and the effect of direct faradic stimulation. Perineural and endoneural neurolysis are recommended when conditions are satisfactory.

In complete division direct suture is the simplest and most satisfactory measure. In some cases this is easy, but when the defect is large, direct suture may be accomplished only by stretching, mobilization of the nerve, transplantation from extensor to flexor surfaces, or tunneling. The ends must be absolutely healthy and must not be too much compressed by scar tissue.

When direct suture cannot be performed some other method must be employed, such as nerve grafting, nerve muscle implantation, free transplantation, bridging or interposition of physiologic tubing. Grafting is suitable when nerves are sufficiently near one another. Nerve muscle implantation has been fairly successful in the hands of Foerster and Borchard. Free transplantation has been successful only with autoplastic grafts. Bridging takes considerable time for regeneration and is not very satisfactory. Interposition is least useful because naked axis cylinders can travel but 2 cm. at most.

When should a secondary operation be considered? The most recent work shows that far more time is required for regeneration than was supposed. After suture, some improvement is usually noted in from three months to two and one-half years in the arm, and even after three years in the leg. Excluding the possibility of technical defects in the operation, it is wise to postpone secondary operation for three or even four years. After grafting, musculoneurotization and free plastic, results are less certain, but according to Foerster results should be expected in from four to six months.

In estimating return of function in paralyzed muscles we must exclude compensating mechanisms, such as substituted movements, apparent movements and vicarious intrusion of foreign nerves either by anastomosis or by extension. This is common in sensory nerves but rare in motor nerves. After some recovery of function, secondary operation should be undertaken when improvement has definitely ceased.

Signs of returning function are first a sharper contraction to the galvanic current, then voluntary movements, and finally faradic excitability. Sensation is less valuable than electrical excitability, principally because of penetration of foreign nerve fibers into the anesthetic field. Valuable signs, however, are improved vasomotor and secretory conditions. Tinel's sign is not mentioned by the author.

When improvement under nerve operations ceases, orthopedic measures are in order, principally tenodesis, or shortening of tendons, and tendon transplantation. On account of the fixation necessary and frequent rigidity resulting, the former procedure is not often used. Tendon operations should not be undertaken until all hope of recovery of nervous function is abandoned. These are the indications given for primary tendon operations: (1) intractable fistulae; (2) extensive scars, dense, and reaching to the bone; (3) severe damage to muscles supplied by the nerve; (4) unfavorable anatomic conditions, such as damage to the nerve shortly before branching or departure from the parent trunk; (5) evident latent infection; (6) excessive nerve defects; and (7) previously operated cases that have been unsuccessful and give no hope from repeated operation on the nerve.

Mauss lays special emphasis on the necessity for waiting sufficiently long after the primary operation before considering secondary operations or orthopedic procedures, and he gives instances in which in view of the long time required, these secondary operations were undertaken, and later evident power returned in the distribution of the nerve first operated on. The same objection holds for appliances. They postpone attempts to use the part and also tend to increase the fixation of the limb and to interfere with the proper circulation. Especially will these appliances give rise to habitual paralyses, even after electrical reactions are normal. Of course in peroneal palsy a brace is necessary to maintain the limb in good position, but in all cases systematic attention should be given to massage, passive and active movements, hydrotherapy and electricity.

Physical therapy is especially indicated in conditions of vasomotor and trophic disturbances in order to avoid alteration in the bony structures and contractures of the muscles. They are necessary above all in plexus injuries.

The author devotes a few pages to the discussion of irritative phenomena in sensory nerves, the so-called wound neuralgias. They are marked by hyperexcitability of sensory nerves and are located principally in the distal portion of the extremity. They are most common in injuries to plexuses, and the median, ulnar and tibial nerves. The anatomic substrates in these cases are most often strangulation, endoneural scars, and foreign bodies, especially bits of cloth. The combination of trauma and infection sets up neuritis which is very troublesome and persistent. The severe cases demand early operation. The best results are obtained by releasing the nerve from the scar tissue, or neuraxiresis. Foerster recommends resection of the damaged portion and suture in severe cases. Another method is freezing by ethyl chlorid, which must be thorough and deep in order to penetrate the nerve and induce lasting effects.

UNIVERSAL INFANTILE DYSTROPHY. S. Hirsch, Ztschr. f. d. ges. Neurol. u. Psychiat. **72:**347, 1921.

Hirsch blames "der Blockade" (the blockade) for the recent increase of infantilism. His twelve patients during the period of adolescence lived under unhygienic conditions, nine being orphans, and most of them suffering more or less from chronic malnutrition. This exogenous factor has been emphasized by Anton, but the pathogenesis Hirsch ascribes to endocrine disturbances. The individuals at the age of 18 to 23 are of short stature and childish physique. Their long bones are open at the epiphyses and in many cases there are signs of rachitis tarda. The changes are not only in the bones, however. Five of the twelve had genitalia of infant size. All of them lacked secondary sexual characteristics, such as hair growth, deepening of the voice, libido, control of the emotions and interest in manly occupations. Most of them had hyperplasia of the lymphoid structures, some were asthmatic, others showed signs of hyperactivity of the vegetative nervous system, all of them showed diminished thyroid function, and some the symptoms of hypopituitarism.

Hirsch believes that enforced poor hygiene such as prevailed during the war, especially in these cases, caused grave endocrine disturbances at that important developmental period, adolescence.

ETIOLOGY OF TABETIC ARTHROPATHIES. KURT GRASSHEIM, Ztschr. f. d. ges. Neurol. u. Psychiat. **72**:119, 1921.

Before advancing his own theory as to the etiology of tabetic arthropathies and pathologic fractures, Grassheim discusses the theories that have been advanced at one time or another to explain these manifestations, about fourteen in number. The most important ones are: (1) degeneration of trophic centers in the spinal cord, (2) trophoneurosis, (3) ascending neuritis, and (4) trauma to tissues undefended by normal reactions to pain.

The frequent occurrence of bone disease before ataxia and before disturbances of sensation either superficial or deep led him to inquire into the nature of the disorder. Chemically he found diminution of calcium and phosphorus in the bones of tabetic patients, to the extent of 30 per cent. Microscopically, he found local destruction of bone, fissure formation and widening of Haversian canals. Further he states: "It is notable that in spite of the activity of the resorptive process, osteoclasts were present in small numbers so that they cannot be blamed for the disturbance. Callus formation is chiefly fibrous, with inlays of osteoid tissue and new formed bone, but osteoblasts are lacking at the periphery."

No nerve degeneration was found in 550 sections stained by various methods. Treatment by administration of calcium salts and organic phosphorus was unsuccessful in arresting the course of the bone disease.

Grassheim believes that the disturbance is one of bone metabolism, and therefore linked with endocrine disturbances. He calls to mind the frequency of endocrine disorders in tabes (impotence, emaciation, glycosuria, etc., together with other less frequent but well-known pituitary and thyroid disorders), and places tabetic arthropathies in this category. His article is extensive and well written, but is a comment on our ignorance of bone metabolism, and especially its relation to endocrine disorders.

FREEMAN, Philadelphia.

EXPERIMENTAL DEGENERATION OF THE VAGUS NERVE AND ITS RELATION TO THE NERVE TERMINATIONS IN THE LUNG OF THE RABBIT. O. LARSELL and M. L. MASON, J. Comp. Neurol. **33**: 509-516 (Dec. 15) 1921.

The vagus nerves supply the preganglionic fibers to the intrapulmonary ganglion cells which are scattered along the bronchi and their branches, as is shown by the disappearance of most of the pericellular networks about these cells following experimental degeneration of the vagus of the same side. Most of these preganglionic fibers come from the vagus of the same side, but some from the vagus of the opposite side. The number of fibers in the bronchial musculature is affected very little, if at all, by the degeneration of the fibers of the vagus nerve. These are, therefore, postganglionic fibers arising probably from cells of the intrapulmonary sympathetic ganglions. A few sensory terminations remain in the lung of the operated side after degeneration of the vagus fibers; these are believed to be derived, in part, from the vagus of the opposite side. The number of nerve fibers in the walls of the pulmonary blood vessels is unaffected by degeneration of the vagus nerve.

THE GROWTH OF THE CENTRAL NERVOUS SYSTEM IN THE HUMAN FETUS AS EXPRESSED BY GRAPHIC ANALYSIS AND EMPIRICAL FORMULAE. Halbert L. Dunn, J. Comp. Neurol. **33:** 405-491 (Dec. 15) 1921.

This is an exhaustive statistical study of 156 human fetuses ranging in length from 3.1 cm. to 53.6 cm. The growth of the central nervous system throughout the fetal period is similar to the growth in body weight at this time. The growth of the central nervous system, on further analysis, shows three distinct subtypes: (1) cerebral growth, which is slow and steady prior to the sixth fetal month (30 cm.) and is more rapid from that time to birth; (2) brain stem and cord growth, which is more rapid from the second to the last of the fifth fetal month than it is thereafter, and (3) cerebellum growth, which is very slow from the second to the last of the sixth fetal month and extremely rapid in the last four months of intra-uterine life.

VERTEBRATE CEPHALOGENESIS. V. ORIGIN OF JAW APPARATUS AND TRIGEMINUS COMPLEX—AMPHIOXUS, AMMOCOETES, BDELLOSTOMA, CALLORHYNCHUS. Howard Ayers, J. Comp. Neurol. **33**:339-404, 1921.

A detailed comparative anatomic study of the species named in the title leads the author to the conclusion that the evolution of the jaw apparatus is not related to that of the gills, as commonly taught. The mandibles are derived from the cirri or tenacular apparatus of *Amphioxus*. The maxillary structures arose later within the cyclostomes. The history of these transformations is outlined and supported by a detailed examination of skeleton, muscles and nerves.

STUDIES ON THE RETINA. HISTOGENESIS OF THE VISUAL CELLS IN AMBLYSTOMA. S. R. Detwiler and Henry Laurens, J. Comp. Neurol. **33**:483-508 (Dec. 15) 1921.

The fully differentiated retina of amblystoma punctatum possesses characteristic rods and cones. In early stages of development the visual cells are all conelike. Rods do not appear in their definite form until relatively late in development. Rods, however, do not differentiate from cones, but at very early stages the conelike elements are of two kinds (present in the ratio of 4:3), which give rise, respectively, to definitive rods and cones.

C. J. Herrick, Chicago.

THE VALUE OF PHENOBARBITAL (LUMINAL) IN THE TREATMENT OF EPILEPSY. L. Cheinisse, Presse méd. **30**:42 (Jan. 14) 1922.

This critical review calls attention to the limitations of phenobarbital (gardénal). There was no effect in some cases of grand mal; debatable effect in petit mal—the writer concludes that some benefit may be expected; rash and sore throat were reported in a few cases; there is danger of status epilepticus when the drug is suddenly interrupted; incidence of intellectual torpor is frequent and there is occasional delirium. Some injury to intellectual activity is almost constant.

The writer comments favorably on the suggestion of M. Ducosté (Note complémentaire sur le traitement de l'épilepsie par la phényléthylmalonylurée, *Ann. méd. psychol.*, July, 1921) that belladonna in small doses can be used with luminal to improve the psychic condition and correct the constipation, together with very small doses of caffein to combat the mental and physical lassitude.

PERIODIC OCULOMOTOR PARALYSIS DURING RELAPSING FEVER.

T. Mironesco, Presse méd. **30**:17 (Jan. 7) 1922.

The author reports a case of oculomotor paralysis on one side, which appeared during an initial attack of relapsing fever, disappeared entirely during remissions, and recurred in its original form during two successive relapses. The attacks of paralysis coincided with the finding of spirilla (Obermeyer's) in the circulating blood. This repeated constant localization was thought to be due to spirilla in the capillaries with a local predisposition, possibly a small hemorrhage. The spirilla were not found in the cerebrospinal fluid in this case, but have often been reported there before, even anticipating the appearance of an initial attack of fever. Hemorrhages have also been described in the meninges in other cases. Attention is called to the importance of these observations now that cases of general paresis are being treated by inoculation of relapsing fever. Eye muscle palsies may be due to complications of the two diseases.

SYRINGOMYELIA WITH SPINA BIFIDA.

M. Klippel and A. Feil, Presse méd. **29**:971 (Dec. 7) 1921.

This case, with necropsy findings, is claimed to be the first of the kind reported in an adult. It is argued that there is some connection between the two malformations, that the syringomyelia in this case was congenital, and that the same cause produced both abnormalities. The two types of lesions, syringomyelia and spina bifida, generally appear to be independent but in this instance they occurred in the same case and constitute a new syndrome of "ependymal-arachnoid hydromyelia."

Huddleson, New York.

APHASIA.

M. Christin, Rev. méd de la Suisse Romande **41**:717-727 (Nov.) 1921.

Since the celebrated discussion of the Neurological Society of Paris, in 1908, little advance has been made in the study of aphasia.

Monakow has pointed out the error that has been made in confusing the localization of aphasia with the localization of language. How severe a lesion is required to produce an aphasia remains doubtful. It is necessary for the anatomist to take into account initial phenomena, residual states, functional elements and bilateral compensation before the anatomic site can be postulated in the various syndromes.

During the past year Head has reviewed the ideas of Jackson (*Brain* **43**: Pts. 2 and 4, 1920). Head's conception of aphasia is psychologic, not based on anatomic verification. In the study of his patients he used methods which are very extensive. His scheme tends to show that identical stimulation may provoke various responses; however, his results are not always conclusive. The method of examination as employed by Head is explained by the writer in full. A series of his tests deal with recognition, imitation, description, calculation and various other phases, as employed in the usual aphasic examination. In studying a large group of aphasias occurring among soldiers, Head thought it possible to abandon the traditional conception of localization. He considers language difficulties as complex even in the more simple anarthrias or motor aphasia. In motor aphasia there is always some alteration of internal language. Head agrees with Marie that in aphasia all parts of speech are affected but in variable proportions. Verbal images are not entirely lost, as the words may reappear under suitable stimulation, even though they cannot be returned at will. It is this phenomena that Monakow, following the terminology of Semon, calls the failure to exphoriate the engrammes.

In aphasia recognition is usually possible as patients demonstrate by gesture that an object or picture is recognized, but there is an inability to get the corresponding word. Words may even be recognized, but they do not evoke the corresponding image or object. The same is true in dealing with a foreign language; there is a suspicion that a word is known, but the meaning fails to present itself. This Head calls symbolic thinking, which is the use of symbols for objects or conceptions. Marie does not believe that we think in terms of words but that all internal reflection occurs in phrases. Many simple acts are executed without presenting themselves verbally. In Head's classification of the aphasias he takes into consideration residuals. There are verbal aphasias, nominal aphasias, syntactic aphasias, semantic or coordination aphasias. The first two types agree fairly well with motor and sensory aphasias. The latter two groups are entirely new and originated by Head. He looks on aphasia as a syndrome which varies only in proportion to divers elements which compose it. He does not believe that a purely motor, visual, auditory or verbal aphasia occurs. The aphasic person has great difficulty in thinking out a problem. Voluntary language suffers more than the automatic or emotional, and often the patient who is unable to repeat a phrase is able, under emotion, to speak it correctly.

Numerous objections have been made by English neurologists to Head's views. Collier leans to the exact anatomic localization of the psychic functions. Stewart also remains true to the classic localization and reports cases following war injuries to illustrate his contention. Unfortunately he has no anatomic proof. Wilson believes that Head's tests are more intellectual than aphasic. He does not see how his tests of imitation show defects in internal verbalization. Wilson agrees with Monakow. He believes that verbal images are perhaps conservers in the form of engrammes without which their voluntary evocation is impossible. Wilson tends to accept Déjerine's classification, and he believes that Head's groups are not clear cut. Stanley Barnes tends to accept Marie's teachings in that he believes intellectual function is internally bound to language.

Before passing judgment the author believes it is well to await the anatomic verification of Head's cases. It does not suffice to deny the localization theory and the work of anatomic clinicians. It is well to compare by analogy this complex speech mechanism which is put into play by language. The author compares the aphasias as follows: A lesion of the third or sixth nerve or nucleus gives a condition analogous to an anarthria. Alteration of the optic nerve, eighth nerve or their nuclei represents the visual or auditory aphasias. Lateral movements of the head and eyes are more complicated, and it is necessary to postulate a lesion of the reticular formation, the posterior longitudinal bundle and of the island of Reil. As the movements get more complicated more of the brain is involved, and the analogy of a sensory aphasia is produced. We therefore may look on speech as a refined motor reflex. In primitive people the response to external stimuli is globule. For good understanding gestures must be relied on, and only with time does the word detach itself from the thing which it represents. Thus from a verbal image it becomes a symbol. The development of language goes on apace with the increase of intelligence and the needs of the person. It is well known that the cortex has the function of differentiation and of discrimination, while the basal nuclei are characterized by a more diffuse reaction. In the psychic sphere it may be said that the basal nuclei have a marked instinctive character, while the intelligence, the faculties of discrimination, are cortical in origin.

According to Monakow's theory of diaschisis, sudden lesions carry with them many associated symptoms. These gradually clear away. Slowly developing lesions, on the other hand, may continue for a long time without any associated symptoms. In the formation of language a great extent of the cortex is activated. The various centers, such as Broca's and Marie's, are only stations at which fibers condense and by injury produce definite isolated disturbance of function, but not wholly attributed to the injury itself. To understand the production, the continuation or regression of an aphasia, it is necessary, following the teachings of Monakow, to study not only the localization of the lesion, but also the nature of the pathologic process, the condition of the brain prior to the trouble, the toxic influences, the disposition of the patient and the means by which language has been acquired.

Language, which is the general mode of expression, is as the white light in the solar spectrum; it is the resultant of all the radiations, localized in one part.

DIAGNOSIS AND TREATMENT OF CORD TUMORS. Emil Redlich, Med. Klin. **17**:1315 (Oct. 30) 1921.

The treatment of cord tumors presents one of the bright chapters in neurology. Horsley, in 1887, was the first to remove a cord tumor. This had been diagnosed by Gowers, and the operation resulted in complete recovery. Since Horsley's work, rapid strides have been made both in the diagnosis and treatment of cord tumors. Today an exploratory laminectomy is looked on as a harmless procedure and frequently establishes an otherwise uncertain diagnosis.

Under the heading of cord tumors, growths arising from the roots and membranes, tumors of the vertebra and also extravertebral tumors must be considered, as they may have to be considered in the differential diagnosis.

Intravertebral tumors may be divided into extradural and intradural growths. The intradural tumors, which are the most important, are divided into extramedullary and intramedullary tumors. It is rare for the dural tumor to extend into the cord. It is just as rare for the medullary tumors to extend into the membranes or into the roots. It is possible, as has occurred in the author's experience, to have two types of tumor in the same patient.

According to Schlessinger, vertebral tumors are more frequent than intramedullary tumors, in a ratio of about two to one. The author believes that this proportion is perhaps too high, and is due to the large amount of postmortem material which Schlessinger had to deal with. Intramedullary and extramedullary tumors, according to the same authority, occur with equal frequency. Oppenheim and others find the extramedullary type more frequent, about three to one.

The dorsal region is the most common location for extramedullary tumors, next the cervical, then the lumbar and sacral. Intramedullary tumors are seen most frequently in the cervical and lumbar regions. Extramedullary tumors have a preference for the posterior surface of the cord.

Intradural tumors usually consist of endotheliomas, especially psammoma-endotheliomas, fibromas and varieties of sarcoma, more rarely lymphangiomas, myxomas and lipomas. On the nerve roots, fibroma—especially neurofibroma—is the common type, occasionally multiple as in Recklinghausen's disease. The author has also seen a fibro-endothelioma and teratoma with dermoid cysts, arising from the cauda equina. It is not unusual to have in the cauda equina malignant tumors, such as sarcomas and carcinomas. These are usually metastatic, most frequently from the prostate or mammary gland. Granulomas are not rare, especially tuberculomas.

Endotheliomas and fibromas may arise from the pia. They may penetrate the cord so as to give a picture of an intramedullary tumor. Malignant tumors may also arise in the pia, as sarcoma which may be multiple. The multiple sarcoma may resemble clinically a meningitis, and by preference select the dorsal side of the cord. Tuberculomas, which are usually intramedullary and frequently solitary, occur in the gray substance of the cord. They may be multiple or associated with cerebral lesions in which there is usually a terminal meningitis. Gliomas are usually intramedullary and may present the picture of a syringomyelia. Gliosarcomas are also present, usually grow slowly, and may become very extensive. Sarcomas may present similar conditions. Gummas are rare, and even more infrequent are neuromas and angiomas.

Extradural tumors are usually sarcomas, endotheliomas and lipomas. Metastatic growths are especially common, such as sarcomas and carcinomas. In a case of pachymeningitis tuberculosis externa, reported by Pelz, there was a classical picture of extradural tumor.

Primary tumors of the vertebra are rare. Sarcomas, osteomas and enchondromas occur and may be operable; usually they are multiple. Myelomas occur, but like sarcoma and carcinoma are usually not of therapeutic interest. Echinococcoses are rare; they may grow out toward the skin and present a cystic mass. Tumors on the surface of the dura are the easiest to operate on, then the root tumors, intramedullary and vertebral.

From the standpoint of symptomatology and progress, cord tumors may be divided into extramedullary and intramedullary types. This is not a sharp line and frequently the exact location cannot be definitely determined. In the extramedullary type there is usually a latent period without any or only vague symptoms. The author has on several occasions in traumatic spine injuries discovered dural tumors that had given no symptoms. Following the latent period there is usually a stage of radicular pain when dorsal roots are involved by the pressure or growth. Intercostal neuralgia, girdle pains and paresthesias are among the common complaints. These may fail, however, or appear very late. The entire course may be without pain. Motor irritation symptoms are rather rare, for, as stated, the tumors are usually on the dorsal side of the cord. The progression of symptoms may take various courses. A Brown-Séquard syndrome may occur. It is noted by the author that the marked hyperalgesia on the side of the lesion, which is noted in animal experimentation, is not present in human beings. The Brown-Séquard syndrome, even if not clear cut, may be suggested by the difference on the two sides of motor and sensory involvement. Early progress may be slow. Later it may be rapid and within a short time paraplegia or tetraplegia may occur. An island-like sensory disturbance, gradually extending cephalward or caudalward, may first be noted. More frequently, however, there is an ascending disturbance. The upper limit of anesthesia does not affect the various qualities of sensation in the same manner. Foerster and the author state that the term anesthesia is the highest involved, next the analgesia and hypalgesia and last the anesthesia and hypesthesia. It is not infrequent in dorsal tumors for the lower sacral segments to remain intact. A marked compression may produce a flaccid paralysis, but the prognosis is not so bad as might be supposed, as even in these cases restitution is possible though more difficult. Bladder disturbances are among the early symptoms; at first there is difficulty in urination with residual urine and later complete retention. A patient with a late case may have incontinence (ischuria paradoxa). Here the cystoscopic examination usually shows a trabeculation of the bladder. In lesions of the cauda or conus which contain the bladder centers, incontinence with cystitis develops early. Besides these cardinal symptoms there are numerous neighboring and distant symptoms, such as pressure signs due to spinal fluid pressure—for example, an ascending anesthesia above the level of the tumor. This may be assumed when in a tumor of the cauda or conus an increase in the leg reflexes occurs, due to pressure on the pyramidal tracts. As distant symptoms one may have, as noted by Cassirer, Foerster and others, the appearance of conus symptoms in dorsal tumors. Nystagmus, abducens and facial palsy have been noted and attributed to this cause. Late in the disease percussion and pressure tenderness may occur. Walking may be painful, it being necessary for the patient to sit up at night. Stiffness of the back, lordosis or kyphosis may occur. Roentgen-ray examination is usually negative.

The clinical picture of a medullary tumor is not as typical as that of an extramedullary tumor. The symptoms tend to be transverse. Gliomas have a tendency to grow lengthwise and may attain considerable size. The symptoms depend very much on the nature of the growth. Gliomas frequently give the picture of a syringomyelia except that the course is usually much more rapid. Atrophy may occur when the lesion is situated in the anterior horns, and only later posterior signs develop. Pains are rather unusual. They may, however, be severe, in which case the picture resembles that of an extramedullary growth.

The author discusses tumors of the vertebra only in so far as they have reference to the spinal cord. It is important to know whether the tumor is primary or secondary. The roentgen-ray is of great help in this connection. The cord symptoms usually appear late, but the onset may be very acute. In this connection caries of the vertebra must be borne in mind, for when caries occurs in the arches the diagnosis is difficult.

The course of tumors of the cord, roots and membranes is usually chronic and progressive. Cases have been reported with a history of ten and twenty-four years, respectively. Occasionally the progress is rapid. Long remissions are not uncommon, especially in intramedullary tumors. In these cases the diagnosis may be doubtful and one necessarily thinks of an arachnitis, which is prone to be more regressive than a tumor. In the differential diagnosis meningitis or arachnitis circumscripta must be considered. Operative measures in these cases produce good results. During the war circumscribed arachnitis was frequently noted. Infections, vertebral tumors, caries, spondylitis deformans, pachymeningitis externa, as also affections of the cord itself, such as multiple sclerosis and funicular myelitis, must be considered. In multiple sclerosis the picture of a transverse myelitis may present itself. On the contrary, nystagmus is not infrequent in dorsal cord tumors, with a loss of abdominal reflexes. Pains also may occur in multiple sclerosis, and even a Brown-Séquard syndrome has been noted.

In recent years the spinal fluid has aided considerably in the diagnosis of cord tumors. While not diagnostic of the various types of tumor, it is especially valuable in distinguishing neoplasms from purely spinal conditions. The compression syndrome of Nonne, which consists of an increase of globulin and albumin and a normal or only slightly increased cell count, is a fairly common finding. Occasionally, however, there is an increased cell count. This usually, but not always, indicates an inflammatory process with compression of the cord, as in caries or pachymeningitis. Xanthrochromia, which is due to a moderate diapedesis, is most frequently found in tumors of the cauda or lower cord, while the simple globulin increase is more frequently found in tumors of the upper cord. Another symptom of spinal fluid interruption is the Queckenstedt phenomena. This is based on the principle of equal distribution of fluid. When a puncture is made and the neck pulled forward, an increase of spinal fluid pressure between 100 and 200 mm. occurs. In tumors this increase, if noted, is slight. On coughing and abdominal compression the pressure will rise, due to the change in the local extradural and intradural venous plexus pressure. In cases of cord tumor there is an interruption of the flow of fluid; thus on puncture there is a sudden gush followed by only a few drops. The compression syndrome and Queckenstedt syndrome tend to blend. The latter gradually evolves during the course of the disease as the author has noted by repeated puncture in the same case. Occasionally in a study of the fluid the author has found tumor cells, also cysts.

The location of the neoplasm is usually determined by the sensory and motor findings. As a rule, only the upper pole is of localizing value, and it is not unusual to find it necessary for the laminectomy to be extended in either direction. The sensory findings are usually much more accurate in localization than motor phenomena. Radicular pains are also of value in the localization. It is well to remember that no segment of the skin or muscle is represented by a single segment in the cord, as there may be over lapping of from two to three segments. In the noted case of Horsley and Gowers the tumor was localized too low because of this fact. It is not infrequent that tumors are localized too high, due to associated swelling, pressure, etc., above the tumor. In dorsal tumors sensory findings are frequently absent and localization is difficult. Foerster has described a special form of tactile disturbance—the recognition of written tactile stimuli on the skin. The author does not consider this of special value.

The relationship of the cord to the vertebral column must also be borne in mind and sufficient room given for this difference in establishing a level. It is also important in dealing with caudal tumors to determine whether the growth is intravertebral or extravertebral. Cassirer believes it is possible to determine this point by examination of the spinal fluid.

The author takes up the question of therapy, especially from the operative standpoint. It is advisable to remove as few arches as possible, but one should not hesitate to remove as many as are needed. A kyphosis rarely develops, and other serious complications are unknown. Removal of the tumor is usually comparatively simple. If situated on the anterior side it may be missed, and it requires considerable care in manipulation to obtain a good view of this portion of the cord. Intramedullary tumors are more difficult to remove, and the result is not always gratifying. To determine the level of the tumor at the time of operation the Queckenstedt sign is of value. If the dura is punctured and there is a free flow of fluid with pulsation, the tumor may be assumed to be located caudally. If the flow of fluid is diminished, of yellow color, and no pulsation, the tumor in all probability will be above the site of exploration. It may also be possible that the process is due to some cord change. In such a case the exploration does no harm and may even do good. In so-called pseudotumors of the cord it is usual, at postmortem, to find some cord change or the tumor situation at a different level. Following operation, symptoms may be aggravated for a while. In the course of a few days improvement in sensation occurs and later in motility. The author and others have seen complete recovery occurring in from four to six weeks. It may, however, require a year.

The regression of symptoms may pass through the same stages as the development. Ataxia may develop as a result of pressure on the posterior columns. Mild spasms, increased reflexes, plantar, extension, may remain as residuals. Bladder symptoms disappear early as a rule. The opposite is usually true in caudal tumors. According to Oppenheim and others, from 50 to 65 per cent. of the patients are cured by operation. In the past few years the author has had twenty-one cases. Of eight patients with dural tumors, five recovered completely; of seven with caudal tumors, three recovered completely, two were much improved, one with a tuberculoma, was somewhat improved; one did not improve and died. Two patients with multiple sarcomatosis of the pia were unimproved and died shortly following operation. The four remaining patients, one with a huge intramedullary glioma, died soon after operation; in one cystic changes of the cord were found with slight improvement after operation. In the two others the subsequent history is not known.

Moersch, Rochester, Minn.

ON STRUCTURAL LAWS IN THE NERVOUS SYSTEM; THE PRINCIPLES OF NEUROBIOTAXIS. C. U. A. Kappers, Brain **44**:2 (July) 1921.

The author first states the points of view of various embryologists on the subject. Hensen said "all nerves originated by an insufficient separation in the primary connections between ganglion cells and their peripheral organs during evolution." Sedgwick is quoted as remarking that "nerves are developments of the reticulum, elongated strands of pale substance composing this reticulum with some of their nuclei." Balfour and His believed that the connections of the nerves with their end organs were secondarily acquired. His saw in it a particularly mechanical problem of embryonic evolution wherein the direction assumed was determined by paths of least resistance. Dustin saw preformed forepaths enabling him to interpret regenerative phenomena in the peripheral nerves. He contrasts the failure of regeneration in the central nervous system and attributes it to an absence of the sheath of Schwann.

Kappers, seeking a clear explanation, fails to find the answer in the conception of the embryologists. He mentions Cajal as being the first to pronounce a tropistic influence, and develops a theory along similar lines. Cajal believed that the connections of the nervous elements are determined by the secretion of "attracting and repulsing substances" and by the sensibility to these substances in the ganglion cells. The chemotactic substances, he states, may be secreted by ependyma cells and also by different parts of the central nervous system, and may enter this stage of secretion at different periods of embryonic development. Conspicuously lacking is any explanatory statement concerning the factors which determine the evolution of the cells and the subsequent secretion of chemotactic substances. Kappers, who had arrived at a similar interpretation of the shifting of cells in embryonic development through studies in comparative phylogenesis, carries the problem a step farther in trying to explain the factors which determine not only the evolution of the cell per se and the subsequent secretion of chemotactic substances, but also the formation of nerve fibers, especially in the central nervous system, and the delicate functional relationships which result.

He believes that the shifting process is very common, and that it is determined by a process of taxis or tropism caused by the stimulation of such cells and their "bio-electric consequences" which determine also the selectivity in neuronal connections and the difference between dendrites and axons, the so-called "dynamic polarization of the neuron." This was elucidated by a study of the topographic differences of homologous cell groups in vertebrates, particularly the motor roots of the oblongata, cord and midbrain. It was found that such topography was determined by the places from which the largest number of excitations reach the cells, that is, with the increase of stimulations in a certain tract, certain cells of the bulb approach this tract and do not migrate to tracts that are not related to it in function. For instance, axonic connections between the visual and vestibular impressions often reach the brain simultaneously.

The author formulates the following: "1. If several stimulative changes occur in the nervous system the outgrowing of the chief dendrites and eventually the shifting of cells takes place in that direction whence the largest number of stimulations goes to the cell. 2. This outgrowing or shifting, however, only takes place between stimulatively correlated centers; temporarily correlated excitation acts a part also in the connections of the axons."

Taking up the dynamic polarization of the neurons, he states that there is a stimulopetal tropism with the dendrites, whereas in the axons there is an irradiation of currents from the center—a stimulofugal process. He quotes Bok who found that when a bundle of unmedullated nerve fibers grows out, passing neuroblasts on its way, the neuroblasts become activated by that bundle and send forth an axon in a direction perpendicular to the activating bundle. This fact was established by finding that neuroblasts lying at a distance from the activating bundle apparently were not activated. The functional end connections of the neuron is attributed by the same writer to a stimulative relationship between the place where the axon starts and the region in which it will end.

Kappers believes that neuroblasts and "placode cells," so long as they have not developed dendrites, may shift with the nervous currents away from the excitation center, but that ripe ganglion cells will not do so. This led to the inquiry as to the determination of the stimulopetal tropism of the dendrites and the stimulofugal tropism of the axons in one and the same cell. It is concluded that a bio-electric influence, galvanotropism, is the leading factor. This is explained as the phenomenon seen in living beings whereby that being or a part of it has the inclination to turn to a certain pole—usually the negative—when influenced by a constant electric current of a very low potential. The reverse process may also be true if the solution of potassium salts is stronger. Cataphoresis in albumin-like materials is compared to nerve constituents and conclusions are reached to the effect that there is a connection between the physiology of excitation and conductivity and a reversible process. A part of the surface of a nervous leader, in excitation forms a cathode with regard to its surroundings—an anodic field. The nerve cells in the proximity of the electro-negative excitation center first produce a positive offshoot corresponding to the irradiation of the nervous current from the excitation center, which is the kationic axon. The positive ions play an important rôle, then, in axon growth, comparable to the part played by different concentrations of electrolytes in the nervous current itself. The axon contains large quantities of potassium compounds, which must favor the stimulo-concurrent character of nerve fibrillae lying in it. Ingvar confirmed the foregoing hypothesis by finding that the outgrowth of the axon may be determined by a constant galvanic current of certain strength. At a much later stage the dendrites appear coincident with the formation of Nissl-bodies which contain oxydases and catalases. At a still later time the cell body shifts toward the center of excitation—in an opposite direction to the axon. The dendrites then have a galvano-tropism directly opposite to the galvano-tropism of the axon, the whole being in perfect harmony with the phenomena of excitation and contraction at the cathode, according to Pflüger's law.

The cathodic shifting of the dendrites and ripe ganglion cells occurs only with those parts of the neuron which contain Nissl substance, whereas the axon, which contains no Nissl-substance, shifts in the opposite direction. The Nissl-substance at first is in a fluid state surrounding the fibrillar structure and contains oxydases—an acid derivative, for example, a compound of nuclein acids and iron. "The liberation and accumulation of the Nissl-substance at the pole of the neuron that is opposite to the potassium accumulation agrees with electrolysis."

Monaxonism and polydendritism are similarly explained. The former necessitates the realization that with a polar tropism the object under influence of a bio-electric current places itself so that the influence is equally great on both sides of the object, producing an equilibrium. When two or more excitation centers simultaneously activate one cell the axis cylinder grows out in the resultant line of both current directions, since it is only in this line that an equal influence of the activating centers is exercised. When one comes after the other, however, the first causes the formation of the axon hillock, and those currents coming afterward utilize the greater conductivity of this zone. This point becomes the favorite conveying path for all stimuli running over or through the cell body. Polydendritism depends on the reaction of the protoplasm which shifts in the direction of stimuli appearing in the vicinity of the cell. Monoaxonism, then, is the result of polar localization of the anodotropic part of the cell, whereas polydendritism is based on the fact that the cell plasm has no place of predilection and is everywhere sensitive to the cathodic tropism.

The selectivity in the formation of neuronal connections is based on the synchronic or immediate successive function of the elements. The budding cone of the axon is the positive potential and cells, which are near it in a state of ionization, present a selective point to the budding axon. Thus the cell or dendrites with which it is going to be connected (synapse) are those which have been stimulated by an action current and present a predilection point. A cell with an immediately preceding state of function forms a center of attraction for budding axons, and the same is true for the muscle contractions which attract the nerve fiber to it in growth. The broad general idea evolved is that during the evolution of tissue, electric conditions occur which are very similar to those which take place in stimulation, and thus connections are made between the nerve fibers and the parts they activate.

PATTEN, Philadelphia.

DIAGNOSIS AND TREATMENT OF MENINGITIS OCCURRING IN AURAL CASES. Charles Ballance, Brit. M. J. **2**:399 (Sept. 10) 1921.

This well-known surgeon states that meningitis is the most complex and dangerous complication of aural disease. He believes that the persistence of disease of the temporal bone is the indication for operation and that one should never wait for the onset of an intracranial complication. In discussing illustrative cases, this author repeatedly points out that the operation in acute mastoid inflammation is not complete until lumbar puncture has been performed. In posterior basic meningitis, Ballance advocates draining of the cisterna magna and breaking through the pial expansion forming the posterior half of the roof of the fourth ventricle.

A CASE OF MYOPATHIC MUSCULAR ATROPHY IN A NEGRO. J. F. Corson, J. Trop. M. **24**:234 (Sept. 1) 1921.

Corson reports a case of Erb's juvenile type of myopathic atrophy in an 18 year old negro boy, with atrophy and weakness on voluntary movement of the trapezius, latissimus dorsi, pectoralis major, biceps cubiti, brachialis anticus, triceps extensor cubiti, supinator longus. Voluntary movements of the serratus magnus were lost. Pronation and supination could be performed. The mobility of the scapulae was increased. The thigh muscles were wasted and weak. The gait was waddling. The erect posture was assumed by the characteristic method. Muscles of the face were not involved. Aphonia was present.

THE SUGAR CONTENT OF THE CEREBROSPINAL FLUID AND ITS DIAGNOSTIC VALUE, ESPECIALLY IN LETHARGIC ENCEPHALITIS. R. Coope, Quart. J. Med. **15**:1 (Oct.) 1921.

The author, summarizing the findings of numerous writers on this subject, calls attention to two points: 1. A high sugar content should not be regarded as a positive diagnostic sign of lethargic encephalitis. 2. A low sugar content (provided the fluid is fresh) is a strong indication of an acute or tuberculous meningitis. Coope examined the cerebrospinal fluid of ninety-five patients for its sugar content, using the method of Folin and Wu for blood sugar. His three normal fluids gave 64, 69 and 83 mg. per 100 c.c.; the eleven cases of lethargic encephalitis varied from 67 to 94 mg. per 100 c.c.; twelve cases of tuberculous meningitis from 18 to 55 mg. per 100 c.c.; one case of pneumococcic meningitis, 19 mg., and one of meningococcus meningitis 8 mg. per 100 c.c.; four cases of syphilitic meningitis 72-100 mg. per 100 c.c. He concludes that the French tendency to regard a high sugar content of the cerebrospinal fluid as diagnostic of lethargic encephalitis is not justified, but that a low sugar content, especially one below 40 mg. per 100 c.c., is strongly in favor of an infective meningitis.

A CASE OF JUVENILE GENERAL PARESIS. G. J. Key and A. Pijper, South African Med. Rec. **19**:343 (Sept. 24) 1921.

The father gave a four plus complement-fixation test for syphilis, and the third child (aged 6 years), in a family of five, a plus-minus reaction. All members of the family except the patient were in good health, and there was no history of miscarriages or stillbirths. When the patient was 6 weeks old he had several convulsions. At 10 months of age he suffered with "sores all over the body." He attended school from the fifth to the seventh year and progressed rapidly. During his eighth year he had to be returned to a lower grade, and then became indolent, irritable and lost interest in his books. In his ninth year he slept poorly and was often noisy at night. When about 10 years old his parents realized that he was failing mentally. He became careless in his habits and personal appearance and had some difficulty in walking. From the tenth to the twelfth year he failed rapidly; he lost all interest in his surroundings, his speech became defective, he would scream without apparent cause, he became slovenly in his habits and had to be fed. His gait was so ataxic that he fell when he attempted to walk. He could utter only a few words but gave signs that he could recognize his parents. On admission to the Mental Hospital he showed no signs of congenital syphilis. However, his pupils were dilated, irregular and did not react to light. The tendon reflexes were exaggerated but equal; ataxia was marked; there were fine tremors of the lips and tongue and his facial expression was vacant and silly. The Wassermann serum reaction was four plus. One month after admission he was unable to articulate but mumbled unintelligibly. The lower extremities were useless, the feet were dull blue. During the fifth week gangrene of both feet was present; on the left the line of demarcation was over the distal ends of the metatarsals; on the right the gangrene extended to the middle of the metatarsals. There was incontinence of urine and feces. Six weeks after admission, the hands, upper lip and tip of the nose became blue, and the skin peeled off when an attempt was made to wash them. Later he had difficulty in swallowing and was unable to retain even milk. Death occurred seven weeks after admission to the hospital.

The report of the necropsy covers the brain only. These authors report the usual external and internal hydrocephalus, but no granular ependymitis of the ventricles, and marked thickening of the pia-arachnoid, especially over the frontal and parietal regions. Microscopically the cortical cell devastation was marked in the frontal lobes, less so in the parietal and temporal portions, and almost negligible in the occipital lobes. The glia cell proliferation was most marked in the parts showing greatest nerve cell destruction. Vascular changes were prevalent in all parts of the cortex and varied from slight perivascular infiltration with plasma cells to complete destruction of the vessel, with hyaline degeneration. In some areas almost normal vessels appeared in close proximity to those showing marked infiltration and hyaline degeneration. Stäbchenzellen were found in many sections. In the cerebellum the cell devastation and vascular changes were less marked. Double nucleated Purkinje cells were observed only once or twice.

In view of the marked vascular changes reported in the brain and the clinical evidence of disease of the vessels of the extremities and face, it is to be regretted that the pathologic condition of the whole arterial system was not studied.

TUMOR OF THE SPINAL CORD. J. M. Gill, M. J. Australia **2**:201 (Sept. 10) 1921.

This author cites the case of a woman, aged 68 years, whose history was uneventful until eleven months prior to her admission to the hospital, when she complained of severe attacks of pain radiating from the spine at the level of the sixth rib, which became so severe that her legs grew weak and stiff.

Fourteen days before admission there was some loss of control of the bladder and of the rectal sphincters, and painful involuntary movements of the lower extremities. Examination revealed: (1) a paralysis of both lower extremities, with the hips and knees semiflexed; (2) involuntary drawing up of the thighs with flexion of the knees; (3) pain in the back between the angle of the left scapula and spine and under the left breast; (4) some loss of control of the bladder and rectal sphincters; (5) a sense of constriction about the waist. The superficial abdominal reflexes were absent; the knee reflexes were slightly increased; the Babinski sign was positive on both sides; ankle clonus was absent. There was tenderness to pressure over the fourth, fifth and sixth dorsal spines, and sensory tests were unsatisfactory on account of the pain produced. At a later examination there was complete anesthesia for pain below the kness, with impaired sensation from the knees to the level of the tip of the sternum. Still later the loss of pain sense was complete up to the level of the xiphisternal line and an hyperesthetic zone about the level of the eighth dorsal spine. Gill made a diagnosis of meningeal tumor of the spinal cord at the level of the sixth dorsal root. At operation a tumor measuring 5 cm. in length was found loosely attached to the arachnoid at the level of the fourth dorsal vertebra. The spinal cord was flattened and did not pulsate. Microscopic examination showed that it was an endothelioma. On discharge from the hospital three months later, the patient could move her legs slightly, sensation was present up to the knees, and the control of the bladder was improved. The author remarks the rarity of such a case in a person aged 68 years.

THE PHYSIOLOGY OF SYMPTOM PRODUCTION IN DISEASE AND INJURY OF THE NERVOUS SYSTEM. F. M. R. Walshe, Brit. M. J. **2**:377 (Nov. 19) 1921.

Jackson's theory of the dissolution of function of the nervous system, the phylogenetic hypothesis of Head and Rivers and the psychic origin of disorders of the body function are discussed briefly and condemned by Walshe. The author then turns to the physiologic factors in the production of symptoms in disease and describes in detail the effect of anoxemia (oxygen-want) in the activity of the nervous system. Acute anoxemia results in defect of memory, attention and judgment associated with marked emotional disturbances, muscular spasms and twitchings, weakness, tremor and ataxia with parasthesias and sensory impairment. Visual and auditory acuity are diminished. These symptoms are transient, and if the anoxemia is of short duration do not result in permanent defects of function. The effects of oxygen-want are seen in the convulsions of the asphyxial states and in the epileptiform seizures which often usher in a cortical thrombosis or accompany free hemorrhage from any part of the body. Irritative symptoms indicative of beginning compression in traumatic intracranial hemorrhage are associated with cyanosis, that is, deficient oxygenation of the brain. When compression renders the affected area of the brain anemic, irritative symptoms give place to paralytic.

Jacksonian seizures in patients suffering with depressed fractures over the motor cortex depend on compression of the cortex and interference with its circulation and not on the irritation of these areas by indriven bone. Walshe believes that the discharges from an hyperexcitable center are not only exaggerated but that they are also altered qualitatively. He doubts that irritative symptoms ever occur apart from impairment of functional efficiency.

BILATERAL RIGIDITY IN MIDDLE MENINGEAL HEMORRHAGE.

Geoffrey Jefferson, Brit. M. J. **2**:432 (Oct. 21) 1921.

After calling attention to the fact that the literature of middle meningeal hemorrhage shows only a few cases with general muscular rigidity, Jefferson reports two cases which may be summarized as follows: Both were in men aged 37 and 26, respectively. One fell from a first story window, the other 60 feet from a roof. Neither were unconscious until about one hour after their accident. When seen by the author seven and three hours after their admission to the hospital the patients presented bilateral rigidity. The lower extremities were extended and strongly adducted. The feet were plantar flexed and inverted. In the first case the rigidity was so marked that considerable force was necessary to change the position of the limbs and any attempt to move them increased the rigidity and produced a fine tremor. In the second case there were tonic contractions of the limbs every three or four minutes, with a marked increase in the rigidity. In his first case the arms were held rigidly extended at the sides with the forearms hyperpronated. In his other case the left arm was extended stiffly in slight abduction, the wrist flexed and adducted; the fingers were partly closed and the thumb adducted. The right arm was flexed (130 degrees) at the elbow, fully flexed at the wrist and the fist held as on the left side. During the seizures the upper extremities presented the same picture as in Case 1. Both patients developed Cheyne-Stokes breathing, and their muscular rigidity was markedly increased at the height of the respiratory movements. In Case 1 the head was turned sharply to the left as were the eyes. The patient in Case 2 showed no rotation of the head. Opisthotonos was present during a few of the tonic seizures in Case 2. The patient in Case 1 presented a widely dilated left pupil. Tendon reflexes were elicited during the interval between seizures in Case 2 but were not demonstrable in Case 1. Ankle clonus was present in both cases, also Babinski's reflex. The abdominal reflexes were absent on the left and reduced on the right side in Case 1. Both patients were operated on by the author. The patient in Case 1 presented a fracture in the anterior part of the left temporal fossa and an extradural clot 12 cm. in diameter and nearly 4 cm. in depth at its thickest part. The clot lay over the left frontal lobe and extended forward and upward. The dura was not opened. The rigidity disappeared at the completion of the operation. Death occurred three hours later. At necropsy nothing further of interest was found. In Case 2, under local anesthesia, a depressed fragment of the right frontal bone 8 by 4 cm. extending up to the midline was elevated and removed. A small clot was found overlying the anterior end of the superior longitudinal sinus. The right orbital plate was comminuted and the dura torn. The patient became flaccid, the seizures ceased and the pulse fell to normal. Two hours later the pulse increased, and he died seven hours after operation without any return of the rigidity. At necropsy an extension of the fracture was found over the left frontal bone with a laceration of the left middle meningeal artery. The resulting hemorrhage was the size of a man's fist and lay over the frontal pole of the left hemisphere.

In conclusion the author states that the rigidities in his cases must have been dependent on changes in the intracranial circulation produced by the extravasations of injury and could not be the result of local irritation. The clinical syndrome depends on a relative deficiency or the reverse of the blood supply to certain regions of the brain and results in the release of lower neuronic levels. It is probable that this syndrome in man depends on a fine circulatory balance, on a relative anoxemia sufficient to suppress cortical control but not great enough to render inactive the causal mechanism in the midbrain and hindbrain.

CRIME AND MENTAL DEFICIENCY. W. C. SULLIVAN, Lancet **201:**787 (Oct. 15) 1921.

Sullivan in his lectures on mental deficiency at the University of London states that conduct may be criminal, but there are no criminal aptitudes, and it is only rarely and in a more or less figurative sense that we speak of criminal impulses. Most crime that is not professional is due to the failure of inhibitory control, or an inability to refrain from the immediate satisfaction of impulse. This failure may be the result of an unduly strong impulse or a weakness of the power that should control and direct it. A study of statistics shows that the proportion of criminals to the population of the same age is at its highest during the period of adolescence, that is, between the ages of 16 and 21 years. The author believes that this is what we should expect if crime is due in any important measure to weakness of inhibitory control. While the impulses of the feeble-minded do not exhibit any constant difference from those of normal persons, it is not uncommon to observe instances in which mental deficiency is associated with an excess or perversion of instinctive activities leading to criminal acts which seem to be related more to abnormality of impulse than to failure of inhibition. Inadequate capacity of control is a regular or permanent feature in many cases of mental deficiency and is presumably the source of the special criminal proclivity characteristic of the mental defective whose mentality is that of an adolescent. The mentally defective person may and often does commit crimes because his mentality does not permit the realization of the consequences of the act. The moral imbecile is not simply an amoral person, he is an amoral person whose debility is more prominent in the sphere of the emotions and the will, but who presents some degree of intellectual deficiency. The author calls attention to the frequent occurrence of moral imbecility in the offspring of epileptic stock, to the occasional supervention of epileptic seizures in the later life of this group, and to the fact that a condition resembling moral imbecility may be the result of a retarded development and not to a permanent deficiency. The pathologic swindler whose ethical defect is of a less generalized character should also be classed as a moral imbecile.

ENCEPHALITIS LETHARGICA. EDWIN BRAMWELL, Brit. M. J. **2:**648 (Oct. 22) 1921.

At the annual meeting of the British Medical Association, Bramwell summarized the investigations of many authors on epidemic encephalitis. He called attention to the signs and symptoms, which he considers of particular diagnostic importance: (*a*) ophthalmoplegia of central origin of more or less acute onset, which sooner or later shows a tendency to improve; (*b*) transient diplopia at the onset of the illness; (*c*) nystagmus, which may vary in rapidity, amplitude and direction; (*d*) paralysis of conjugate upward movement of the eyes associated with little or no impairment of ocular movement; (*e*) drowsiness and lethargy of varying degree accompanied by intelligent though slow response to questions; (f) the masklike face and postural attitudes, suggestive of paralysis agitans; (g) mental disorientation similar to that seen in chronic alcoholism, and (*h*) myoclonic, athetoid and choreic movements.

POTTER, Mercer, Pa.

PROGRESSIVE LIPODYSTROPHY. W. M. KRAUS, Rev. neurol. **28**:357 (April) 1921.

Kraus presents a clear-cut case, the twenty-third of the typical form to be reported. The patient was a young woman, aged 22, with an apparently otherwise negative personal and family history, in whom the lipodystrophic state had existed for fourteen years. At the time of examination the cardinal features of the disorder were typically present—relative and symmetrical wasting and reduction of adipose above the level of the first lumbar segment, particularly of the face and thorax, with marked fatty increase, also symmetrical, below this point, especially of the thighs and buttocks. The legs, to the ankles, were abnormal in size, giving the impression of a hard edema but without pitting—in fact, strikingly of the trophedematous cast—and the skin was observed to be rather thick and rugose.

The author comments on the obscurity of the actual etiology and pathology in this condition, directing especial attention to the occurrence of certain fundamentally resemblant features in both this disturbance and trophedema. He suggests that progressive lipodystrophy might conceivably be regarded as a basically trophedematous state with superadded fatty changes in the subcutaneous field, thus emphasizing from a somewhat different angle, the possibility mentioned by Boissonnas, of underlying autonomic imbalance or dissociation as of fundamental significance in the etiology of this disorder.

There are two excellent illustrations.

CRANIAL DYSTROPHY SUGGESTING OXYCEPHALY. E. D. PAULIAN, Rev. neurol. **28**:358 (April) 1921.

Paulian's case was that of a woman, aged 30, presenting a rather striking anomaly of skull contour associated with loss of vision and rather frequent epileptiform attacks. According to the history, the patient had suffered an attack of "cerebral fever" at 18 months, followed by typhoid three years later. At 5 she suddenly became blind; about this time, a rotary nystagmus and exophthalmos also became manifest, the latter, seemingly, having become progressively more marked. Epileptiform attacks, rather typical in type, first appeared at 15 and had been noted ever since, occurring at intervals of four or five weeks, both nocturnally and during the day. Headache was not reported, and no mention was made as to psychiatric or endocrino-autonomic status.

Examination revealed definite, although not extreme, flattening of the skull transversely, especially anteriorly, with slight prominence of the superior frontal border, great diminution as to the frontal bosces and leveling of the superciliary ridges, with some degree of depression of the bones of the face and obliqueness of orbital alinement. Roentgenologic study of the skull revealed marked basal lordosis with effacement of the orbital and sphenoidal sinuses, enlargement of the sella which appeared to be of the bilobic type and slight bregmatic prominence, with no indication, however, of intracranial ridging or digitation. In that sense, and in view of the flattening of the vertex and the absence of turricephaly, the picture was somewhat atypical as regards the classical oxycephalic type. There was, in addition, marked exophthalmos and rotatory nystagmus, bilaterally, with distinct outward and downward direction of the eyes. The pupils were dilated, with fixation to light, and ophthalmoscopic examination revealed marked bilateral optic atrophy of the postinflammatory type. The right leg was 8 cm. shorter than the left and definitely atrophic in all dimensions.

In view of the early history and but partial oxycephalic syndrome, the author is disposed to regard this case as basically representative of postencephalic sequellae of long standing in a person presenting the oxycephalic skull type in intermediate degree and probably not of itself sufficient to account for the clinical symptomatology as determined.

OCCUPATIONAL DYSKINESIA—PARESTHETIC TYPE. C. HOULLION, Rev. neurol. **28**:348 (April) 1921.

The author comments on the perplexing problem presented by the occupational spasms, so-called, directing attention to the importance, in this field, of Duchenne's work, according to which such disorders are classified as motor and sensory, including under the former the akinetic, hyperkinetic (classical cramp) and ataxic (tremors, choreiform and ataxic movements) types. The purely sensory type, of which Houllion's case is an example, is deemed extremely rare, but, on the other hand, sensory disorders of some kind, such as anesthesia, paresthesia and "neuralgia," are frequently encountered as complicating features in the more essentially motor types.

Houllion's case was that of a seamstress, 56 years of age, with a negative family and personal history, except that both the patient and her mother were described as of a "nervous" temperament. The present trouble dated back three years and manifested itself primarily as a severe tingling and numbness in the fingers and hand (right), occurring characteristically in the morning, particularly after the patient had sewed for a long time or had done extensive laundering the preceding day. This trouble was usually first noted about fifteen minutes after she commenced to sew in the morning, and beginning in the finger tips, gradually extended so as to include the entire hand, with short periods of intermission, continuing until it was no longer possible to hold the needle. At such times the hand appeared ischemic with an accompanying sensation of frigidity but with no associated spasm or rigidity. On dropping the needle and holding the hand pendent or immersing it in hot or cold water, the paresthesia soon disappeared, only to recur, however, on the resumption of sewing. This situation would repeat itself from six to eight times, following which the patient was able to sew for the balance of the day without further discomfort. Curiously, no disturbance was found to occur if the patient preceded her morning sewing by a period of other work, and no difficulty was ever reported at night. The course of the disorder had apparently not been progressive and had been marked by phases of complete remission over periods—one of them several months in duration—when needlework had been discontinued.

Neurologic examination was negative except for slightly increased sensitivity of the right arm trunks to electrical stimulation.

Mention is made categorically of the various hypotheses which have been advanced as to etiology, the author seeming to favor that of perverted vasomotor habit or "neurosis" dependent, presumably, on basic autonomic imbalance or dysfunction.

PATHOGENESIS OF GENERAL PARESIS AND TABES. A. Sezary, Rev. neurol. **28**:337 (April) 1921.

Sezary directs attention to the rather striking contrast between general paresis and tabes and syphilis of the more essentially somatic or constitutional type, particularly as to the late cutaneous and visceral forms with which the former are often associated. These constitutional lesions for the most part are essentially sclerogummatous in character, while the neurosyphilitic changes. particularly those of paresis, are primarily not of this type, representing rather a perivascular and interstitial inflammatory reaction with specific associated cell and fiber alteration. The sclerosis that occurs is construed as secondary to preceding neuraxial degenerative change; as a matter of fact, according to Sezary, the general histopathology here is, in a measure, rather suggestive of the chancre type. It is of peculiar significance also that in these disorders, especially the paretic type, spirochetes are practically never found in the meninges although they are abundantly determinable in and about the cortical cells. Of interest, too, is the fact that the spinal fluid in these cases is usually avirulent and that the blood Wassermann reaction is generally reducible while that of the fluid is not. The author therefore feels that such disorders are due to primary spirochetal change in the neuraxial tissue associated with transient or intermittent humoral invasion. From this standpoint, Sezary concludes that neuraxial tissue possesses a certain partial natural immunity against the spirochete, of sufficient degree in most cases to inhibit greatly or to retard the development of these organisms, which probably reach the neuraxial field rather early in the infection. and as a result of which these tissue elements do not participate in the general constitutional immunization effected shortly following secondary systemic spirochetal invasion. Finally, however, in many cases the latent neuraxial infection is able to break through this local inhibitive influence and develops lesions of a primary diffusely inflammatory and degenerative type, quite atypical, as indicated, in comparison to those characteristic at this time of the constitutional or more essentially humoral field.

There is a relatively meager therapeutic response in neurosyphilis, particularly as regards the arsenicals, because, according to the author, this type of tissue, owing to its peculiar chemism, appears unable to oxidize properly such compounds, a step, seemingly, absolutely sine qua non to the effective mediation of specific pharmaceutical reaction.

Raphael, Ann Arbor, Mich.

STRATIFICATION IN HYPNOTIC SELF-OBSERVATION. J. H. Schultz. Monatschr. f. Psychiat. u. Neurol. **49**:137 (March) 1921.

The author reports the results of his experimental observations.

The tests are carried on with the patient lying in a darkened or half darkened room. The eyes are kept closed, and he is told to note the subjective phenomena occurring in the "visual field" and to describe exactly what he sees.

The material always appears in three forms, which follow each other as the hypnosis gradually deepens.

1. The first layer consists of the usual formless colors, spots, veils, lines. half shadows, lattice, rings, etc. They are localized "in the eye" or "in the field of vision" and are often spontaneously compared with after-images. This stage of "raw material" is often very short, and may be overlooked unless attention is directed toward it.

2. The second stage is the stage of thought visualization. Usually it appears as the finished thought product—as a picture localized in the visual field. Occasionally the picture is seen forming from individual elements, and when formed, passes out like a moving picture film, the patient feeling himself the observer.

3. The third stage is quite different. Things appear which have a definite sense of reality but which are entirely foreign to the person—often things of fantastic form and size, with curious color schemes and without comprehensible meaning. Undoubtedly in this third layer lies much of the material which in pathologic cases contributes to the material of hallucinations.

In the first two strata, composed respectively of formless visual material and visualized thought, the material is appreciated as belonging to the individual. The third layer, primitive layer, contains material foreign to the individual (unconscious). It is remarkable that the third layer can be reached without the developing of amnesia on awakening. Certainly it represents a physiologically changed state of the brain. It is probable that the majority of normal night dreams run their course in the second layer, especially the connected, episodic dreams of light sleep. When dreams reach the third layer, they are probably difficult to recall, just as this same stage is difficult to recall in hypnotic self-observation.

BRAIN TUMORS (NOTES ON THE QUESTION OF CEREBRAL LOCALIZATION). HERMANN FORTIG, Monatschr. f. Psychiat. u. Neurol. **49**:89 (Feb.) 1921.

When one considers how intimately the various portions of the brain are connected with each other, and how profoundly one part is affected by damage to a distant part (Monakow's diaschisis), it becomes impossible to believe in any strict theory of localization which places in a circumscribed area of the brain a definite group of concepts or sector of intelligence. On the other hand, there is no question but that different cerebral zones are functionally different. The mass of facts already accumulated bearing on the problems of cerebral localization is so great as to be confusing.

Rieger has attempted to view the whole problem from a simplified point of view. He divides the brain into two portions, forebrain and hindbrain, the line of division being the central sulcus. To the hindbrain he attributes the general function of perception; to the forebrain, ideation. Fortig calls attention to the fact that this division corresponds with Kant's division of the sources of all human knowledge into two—perception and ideation.

In line with Rieger's view is the fact that anatomically we find all the sense organs represented posterior to the central sulcus. These sense centers, however, occupy only a small part of the hindbrain. A much larger part is taken up by the extensive temporo-parieto-occipital association tracts. This great association zone was formerly looked on as a silent area, but now is known to be directly concerned with the formation of spatial concepts. Fortig discusses in some detail the ideas of the Würzburg school (to which he belongs) relative to spatial concepts. All objects that we see and feel are seen and felt as "circumscribed space." The various disturbances in our knowledge of the outside world which have been grouped under the various titles of mind-blindness, astereognosis, agnosia and asymbolia, are essentially dependent on a disturbance of the spatial concept. The patient who is mind-blind sees, but the object at which he looks is no longer recognized in its spatial relations. The same is true of many apraxias, agraphias and alexias.

In the hindbrain are located perception and spatial orientation; in the intermediate zone, between the forebrain and hindbrain, motor and sensory speech; and in the forebrain, ideation. The author conceives as the characteristic function of the forebrain the grouping of lower concepts to higher and higher abstract units—ideas. He grants that this conclusion is based on exclusion and not on anatomic foundation. Certain facts seem opposed to it, especially those cases of frontal lobe lesions with "negative" findings clinically. But, as the author points out, we are totally incapable of appreciating the finer changes in the psychic life of a person. People vary so in their capacities and their acquirements that what is normal for one is subnormal for another, and only grosser changes are manifest. As an additional function of the forebrain, first described by Auerbach, he mentions lack of initiative.

Summary: The hindbrain serves chiefly perception and spatial orientation. The forebrain serves the higher abstract world, the world of initiative. In between lies the central brain which is the world of conscious acts, including motor speech. But this is not a strict localization, for he recognizes that functions assigned to the various parts are merely predominantly in these parts. We must consider the whole brain as an intricate network with here and there zones of specially increased density to serve special functions. The essence of our psychic life is a binding and grouping of the most complex order, and if we will interpret it we must approach the problem from the dynamic standpoint.

Society Transactions

BOSTON SOCIETY OF PSYCHIATRY AND NEUROLOGY

Regular Meeting, Jan. 19, 1922

James B. Ayer, M.D., *President*

PRELIMINARY REPORT ON EXPERIMENTAL CONVULSIONS: CONVULSIONS PRODUCED BY ADMINISTRATION OF CHEMICAL SUBSTANCES. Presented by Drs. Schichi Uyematsu and Stanley Cobb.

Epileptiform convulsions can be produced by the administration of various chemical substances. So far as we are able to ascertain from the literature, enchonidin, picrotoxin, and absinth appear to produce convulsions very similar to those of epilepsy.

Following an injection of wormwood oil in a dose just sufficient to produce convulsions (0.04-0.07 c.c.), a rabbit, after from three to ten minutes, becomes quiet and then begins to tremble; light twitches of the face, ears and neck muscles follow, becoming stronger and stronger; then a clonic convulsion of rapid tempo (tonic) occurs immediately, first in the forelegs, afterward in the hindlegs. The head is drawn backward on the neck, the forelegs stretching forward in tonic spasm. With the violent convulsions the animal moves involuntarily backward. During these generalized convulsions clonic champing of the jaws, marked frothing at the mouth, crying and involuntary urination and defecation are noticed. In this period the pupils are dilated. The clonic spasm of rapid tempo imperceptibly changes to a running motion (alternating flexor and extensor spasms) which becomes slower and slower and finally ceases. The animal then keeps quiet and appears sick, with rapid respiration and palpitation. The convulsions differ considerably, according to the dose used. The dose sufficient to cause twitching of the aural and facial muscles and slight clonic spasms of the forelegs is called a threshold dose in our experiments.

The opinions of authors differ considerably in regard to the site of discharge and the form of convulsions originating from different levels. But these differences in results of the various workers seem to us explainable on the ground of ignorance of the doses given: that is, the convulsant drug was never quantitatively controlled. Also other factors, such as anesthesia, technic of operation, ligation of vessels, etc., which would change the excitability of various centers, were not sufficiently considered.

From our own experiments (five) and a review of the literature, it seems justifiable to conclude that:

1. Convulsions can be discharged from any part of the neural axis.
2. With the cerebral cortex intact, animals show convulsions after the administration of a much smaller dose of convulsant drug than after decortication or decerebration. Spinal preparations require much larger doses to cause convulsions.
3. With the central nervous system intact or with injury to parts of the cortex not directly associated with motor activity (for example, occipital

lobes), wormwood oil convulsions are epileptiform, as described in the foregoing. After decortication, decerebration and spinal cord transection, the clonic convulsive movements are of slower tempo. In the latter case they are rapid above and slow below the cord lesion.

Having heard of the beneficial effects of fasting on patients with epilepsy treated by Dr. H. M. Conklin of Battle Creek, and having observed the work of Dr. H. R. Geyelin of the Presbyterian Hospital in New York, we undertook experiments to find out whether fasting in animals would reduce their susceptibility to convulsions. The convulsions were produced with wormwood oil, and each rabbit was carefully tested out to ascertain his threshold dose. The results of starvation are shown in Table 1.

This work is open to the criticism that the doses are so small that a mistake of 20 or 30 per cent. might easily be made.

The effect of starvation seems to be to reduce the susceptibility of rabbits to convulsions. Just what factor in starvation is responsible for this effect is difficult to determine. One possibility seems to be the lowered metabolism known to accompany starvation. We therefore took a series of rabbits and intoxicated them with thyroxin. The effect in relation to convulsions is seen in Table 2.

Again there is decreased susceptibility to convulsions; this time with metabolism raised. Therefore, changes in basal metabolism would seem to be ruled out as an important factor in the production of convulsions.

A third series of rabbits was operated on for thyroid removal. The results of experimental convulsions on those that survived long enough to have a reduced metabolism is indicated in Table 3.

Thyroidectomy apparently increases the susceptibility of rabbits to convulsions. This result is in accordance with similar experiments carried out by J. and H. Fischer. They state that thyroidectomized animals are more susceptible to amyl nitrate convulsions than normal animals.

Before we can draw any conclusions as to the factors which increase or decrease the susceptibility of the animals to convulsions, obviously we shall have to test out other conditions which vary in such experiments.

DISCUSSION

Dr. Donald Gregg: In the starvation treatment, do you differentiate between fats, sugars and proteins, or do you cut them off altogether? Are liquids also curtailed? And if so, is not the decrease in convulsions possibly due to a decrease in body fluids, especially the cerebrospinal fluid?

Dr. C. Macfie Campbell: In starvation of animals there are changes comparable to acidosis.

Dr. Karl Bowman: At the Psychopathic Hospital a young girl with epilepsy was admitted who showed a basal metabolism of —21. We gave her dried thyroids, one grain a day, and the petit mal attacks which had been occurring at the rate of thirty-nine a day have not exceeded ten a day since the patient has been receiving thyroid. One day when the thyroid was omitted the attacks were much more severe. We then increased the dose to 2 grains a day, but the pulse rate is going up so that we may not be able to push it further. With one grain a day the basal metabolism was —16.

Dr. Cobb, closing: These patients were completely starved except for water which they seemed to take without difficulty. The work began following the experience of an osteopath who for ten years has been starving epileptic patients and who has reported some remarkable results. I think he says that

TABLE 1.—The Effect of Starvation on Wormwood Oil Convulsions

Serial No.	Lab. No.	Threshold Dose	Original Weight	3d Day Starvation	4th Day Starvation	5th Day Starvation	3d Day Feeding
1	70	0.05 c.c. Slight convulsion	2,940 gr.	0.05 c.c. No convulsions Wt. 2,780 gr.	0.06 c.c. No convulsions Wt. 2,550 gr.	0.06 c.c. No convulsions Wt. 2,300 gr.	0.05 c.c. Marked convulsions Wt. 2,770 gr.
2	78	0.04 c.c. Fairly marked convulsion	1,770 gr.	0.04 c.c. No convulsions Wt. 2,500 gr.?	0.06 c.c. No convulsions Wt. 1,350 gr.	Died Wt. 1,220 gr.	
3	90	0.05 c.c. Very slight convulsion	2,850 gr.	0.06 c.c. No convulsions Wt. 2,500 gr.	0.06 c.c. No convulsions Wt. 2,300 gr.	0.06 c.c. No convulsions Wt. 2,200 gr.	0.06 c.c. Very marked convulsions Wt. 2,580 gr.
4	91	0.05 c.c. Slight convulsion	2,720 gr.	0.05 c.c. No convulsions Wt. 2,020 gr.	0.06 c.c. Slight convulsion Wt. 1,620 gr.	0.06 c.c. Slight conv. Died Wt. 1,470 gr.	
5	92	0.06 c.c. Slight convulsion	2,750 gr.	0.06 c.c. Slight convulsion Wt. 2,560 gr.	0.06 c.c. No convulsions Wt. 2,400 gr.	0.07 c.c. Convulsions Wt. 2,200 gr.	0.06 c.c. No convulsions Wt. 2,510 gr.
6	93	0.06 c.c. Slight convulsion	2,860 gr.	0.06 c.c. Slight convulsion Wt. 2,680 gr.	0.06 c.c. No convulsions Wt. 2,490 gr.	0.06 c.c. No convulsions Wt. 2,190 gr.	0.06 c.c. Slight convulsion Wt. 2,590 gr.
7	70	0.05 c.c. Slight convulsion	2,770 gr.	0.06 c.c. Slight convulsion Wt. 2,680 gr.	0.05 c.c. No convulsions Wt. 2,380 gr.	0.06 c.c. Slight convulsion Wt. 2,170 gr.	0.05 c.c. Slight convulsion Wt. 2,500 gr.

TABLE 2.—The Effect of Thyroxin on Wormwood Convulsions

Serial No.	Laboratory No.	Threshold Dose	1st Day, 1.5 mg. Thyroxin	3d Day, 1.5 mg. Thyroxin	5th Day, Wormwood Oil	7th Day, Wormwood Oil
1	90	0.05 c.c.	Pulse 135	Pulse 204	0.05 c.c. No convulsions Pulse 260	0.07 c.c. No convulsions Pulse 250
2	70	0.05 c.c.	Pulse 136	Pulse 170.	0.06 c.c. No convulsions Pulse 236	0.07 c.c. No convulsions Pulse 220
3	93	0.06 c.c.	Pulse 140	Pulse 180	0.07 c.c. No convulsions Pulse 240	0.09 c.c. Marked convulsions Pulse 216
4	122	0.08 c.c.	Pulse 140	Pulse 184	0.08 c.c. No convulsions Pulse 216	
5	123	0.07 c.c.	Pulse 136	Pulse 186	0.08 c.c. Convulsions Pulse 224	0.07 c.c. No convulsions Pulse 210
6	70	0.05 c.c.	Pulse 145	Pulse 190	0.06 c.c. No convulsions Pulse 228	
7	92	0.06 c.c.	Pulse 150	Pulse 180	0.06 c.c. No convulsions Pulse 226	
8	93	0.06 c.c.	Pulse 145	Pulse 184	0.06 c.c. No convulsions Pulse 236	

TABLE 3.—Effect of Wormwood Oil on Thyroidectomized Rabbits

Laboratory No.	Threshold Dose	Time After Operation	Dose	Result
N-21-145	0.05 gr.	2½ months	0.05	Marked, prolonged convulsions
N-21-147	0.04 gr.	2½ months	0.04	Very marked, prolonged convulsions
N-21-176	0.04 gr.	1½ months	0.04	Marked convulsions
N-21-181	0.04 gr.	1 month	0.04	Very marked convulsions
N-21-190	0.04 gr.	1 month	0.04	Marked, prolonged convulsions
N-21-195	0.05 gr.	1 month	0.05	Mild convulsions
N-21-199	0.05 gr.	1 month	0.05	Marked convulsions

he has had conspicuous improvement in about three quarters of his cases, but he has kept no satisfactory records. About two years ago Dr. Geyelin began this treatment at the Presbyterian Hospital. Some of his patients have had no convulsions for from nine months to a year and a half. This starvation effect may comprise several factors: lowering of the basal metabolism, weakness of the animal, acidosis. Answering Dr. Campbell: I think we have acidosis, but we have not followed up the biochemistry. Acidosis may be a very important factor. Answering Dr. Courtney: The blood pressure has not been studied following the thyroid feeding.

EVALUATION OF INTELLIGENCE TESTS IN CRIMINAL CASES.

By Dr. George L. Walton.

While intelligence tests are valuable in their appropriate sphere, they are likely to prove of little aid in determining the responsibility of the criminal adult. This is illustrated by two cases. The first was that of an uneducated Italian who was self-supporting and sent money home. In company with other adults he had an altercation with an officer in the course of which he drew a revolver and shot the officer. After his arrest he denied the act and offered an alibi, but later confessed. The only material evidence offered bearing on feeblemindedness, except the Binet test, was the statement of his brother that he was not very intelligent, and testimony that he played ball, etc., during the noon hour with boys with whom some witnesses said other adults did not play; others said they did. By the Binet-Simon test his mental age was 9. To interpret the test as pointing to feeblemindedness in such a case is to underrate the most important factor in the diagnosis, namely economic efficiency, and to lay the test open to an adverse comment which it in no way deserves.

The second case was that of a young man who took part in a robbery. In making his escape he shot and killed the shopkeeper. He was examined a month and a half before the trial. At this time he correctly subtracted 33 from 100 and 15 from 50; he counted up to 20 and back with one repetition. Examined again shortly before the trial, he did so badly that he was given a mental age of 6½ by the Binet-Simon test. Examined a third time just before the close of the trial, in which feeblemindedness was a feature of the defense, he appeared unable to count up to 5, and gave other answers which taken at their face value would have indicated that he was little better than an idiot. The obvious lack of cooperation on his part, shown by the rapid apparent deterioration, counteracted whatever value the test may otherwise have had either as an aid in the diagnosis of feeblemindedness or in measuring the degree of feeblemindedness if such existed. This lack of cooperation is not unlikely to appear in the case of the criminal with a defense of feeblemindedness, whose interest is not served by the display of a high degree of intelligence.

DISCUSSION

Dr. A. W. Stearns: I testified on the other side in this case, and I think when a person says that the Binet test is of no value he is making a rather intemperate statement, while I grant that under the circumstances outlined it is of very questionable value. The important thing in this case was the fact that the courts prior to this case had never passed on the responsibility of the feebleminded. None of the witnesses for the defense testified that this man was insane. They said that he was feebleminded and had the responsibility of a feebleminded person.

Dr. D. A. Thom: When one considers this prisoner's (or patient's, as I prefer to call him) reaction and attitude to the court proceedings, his absolute lack of interest in what was going on, his inability to follow in any way the court procedure, not knowing the judge, jury, or physicians, and having little idea of who was for him and who was against him, one cannot help feeling that the man was different. When asked during the trial, "What is going to happen to you if they pronounce you guilty?" he said, "Oh, I'll fix that up all right. I'll go and see the judge." He was obviously undisturbed by the probability of death which awaited him.

It seems inconceivable that any one could review the life of this man and reach the conclusion that he was normal. By that statement I do not mean that he should be relieved entirely from the responsibility of his crime.

I find that the Binet test, as one of several factors in the determination of the mentality of the individual, is of great value. No one pretends to depend on it or any one test for a diagnosis of feeblemindedness.

Dr. William Healy: Feeblemindedness is not necessarily the same thing as mental defect. The committee which in 1912 endeavored to formulate for the American Association for the Study of the Feebleminded a definition of feeblemindedness, that the feebleminded person was one who, by reason of mental defect that had existed from birth or near time of birth, was unable to compete on equal terms with his fellows in the same social environment. The committee also stated that the feebleminded person was one who could not pass the 12 year Binet tests. Since then we have all of us changed our opinion on this matter—that level is too high. But it must be insisted that feeblemindedness connotes certain special disabilities. If a person has a mental age of 10, we will say, and still is able to get along in his environment, he is not to be denominated feebleminded.

In test work with delinquents and criminals one has to insist on the evaluation of test results in the light of the attitude on the part of the person tested. When it comes to the question of defining human responsibility, I confess myself in the light of all these years of experience, as feeling great weakness in making any decision except in the most outspoken cases of deliberate planning of delinquency or in frank cases of mental disease or defect. Responsibility is a metaphysical conception, utilized by the legal profession on a basis of tradition. It involves nothing that can be proved, and it is one of the great stumbling blocks in the way of good work in the criminal courts. Psychiatrists are forced by legal procedure to attempt to answer the problems in these terms, with very little credit accruing in any way. Perhaps murder trials, such as Dr. Walton cites, are rather an exception.

I am convinced that psychiatry has a glorious future, not so much in the mere examination of criminals with the idea of classifying them, but that we may become more efficient in taking care of delinquent persons so that delinquency will be diminished. This is something that we are certain of because the proofs are at hand. By intelligence tests and the study of personalities and behavior trends and of the dynamics of the situation, we can be of some assistance in helping the courts to solve the problem. But I am not at all sure that it will ever be in terms of responsibility.

The present demand for psychiatrists who are really students of delinquency is very interesting. One of the big foundations of New York is going into the problem of delinquency and spending $160,000 a year for five years in order to demonstrate the value of preventive measures. A clinic is being established in New York; some support is being given to the Boston situation; a flying clinic is being sent out to the courts of other cities; a county in New Jersey is being aided in its problems. A psychiatrist, psychologist and social worker in all these separate endeavors are to work together.

Dr. Walton, in closing: I agree with Dr. Thom in regard to the importance of the intelligence tests, and supposed I had put myself on record as fully appreciating them. It is in such cases as I have reported that they seem to me to fall short. I am glad to adopt the suggestion of Dr. Stearns, and substitute the expression "questionable value" for "no value." The verdict in both these cases was murder in the second degree; the sentence, state prison for life.

MULTIPLE SCLEROSIS. By Dr. E. W. Taylor.

Dr. Taylor reviewed the papers on multiple sclerosis presented at the December meeting of the Association for Research in Nervous and Mental Diseases. (Many of these appear in this issue of the Archives.)

THE SOCIETY FOR MENTAL HYGIENE. By Dr. C. Macfie Campbell.

The daily papers have been using the term "mental hygiene." Parlor meetings have been held in order to bring about an interest in this subject and it seems to be in danger of becoming a popular topic of conversation. It may be worth while to study the close relationship between the work of a volunteer organization in mental and nervous disorders and the work of groups of specialists. One must keep in mind that the social conditions under which patients live determine something of the symptomatology of the disorder and that various factors which may not be taken into account in ordinary laboratory investigations may be of considerable scientific importance. Insanity could not be studied accurately until the chains of the insane were struck off. A great many of the phenomena they presented were due to irritation by cruel attendants, physical conditions, abuse and neglect, rather than to any intrinsic nervous disorder. Medical research and the utilization by the public of medical knowledge must always go hand in hand if we are going to make progress in improving the health of the community. If we are going to have a clean water supply and make conditions as hygienic as they ought to be, we must have a popular interest in such matters, and in order that popular interest may have the thorough endorsement of the responsible medical workers. Those not technically familiar with a health situation will naturally ask those who are acquainted with it whether a movement is a solid, intelligent public health movement, or whether it is more or less an ill-balanced and sentimental philanthropic movement. So one may bring up two questions: 1. Is the field adequately prepared by mental hygienists? 2. Is there any necessity for a volunteer organization; is the field not sufficiently covered by federal and state authorities?

The field of mental hygiene is much wider than is generally realized. Psychiatry in the past has dealt too exclusively with the end products or the more severe types of mental disorder, and it is our place to put before the medical student a better perspective with regard to mental disorders. We deal with incipient cases and emphasize to our students the necessity of the early recognition of symptoms. The field of mental disease which is represented by the severe cases of so-called insanity is in many places adequately covered by the state. Within the last fifty or seventy-five years the state has recognized its responsibility in caring for patients with serious cases of mental disorder; not all states, however, for there are many which offer inadequate care although there may be abstract recognition of state responsibility.

For many patients with mild cases of mental disorder, who hesitate to go to a state hospital, of whom physicians in general say "It is just a nervous breakdown," and for whom they recommend merely rest and palliative treatment, there is inadequate provision. Except in a few large centers that type of person does not receive the hospital care which people with any other type of disease receive. That situation is a matter of great importance to the community because it is at that stage of the disorder that most can be done, and there is the greatest hope of curability. A large number of cases are never regarded as mental disorders; for instance, cases of nervous invalidism, heart cases, patient with gastro-neuroses who haunt the gastro-intestinal clinics, genito-urinary invalids who haunt the genito-urinary clinics; these patients are apt to be considered nuisances, and there is no organization in many large hospitals for their definite treatment. In addition, therefore, to cases of incipient mental disorder, and mental cases masquerading under forms referred to, we have other forms of mental disorder represented by the alcoholic patient, the prostitute and those concerned in other social problems. These groups represent a problem in mental hygiene, a problem of great medical interest and, from the point of view of the community, of great social and economic importance

In the school system, through which all the children of the community pass, we are trying to raise the general health of the public by attention to the teeth and tonsils, but it is as important to give attention to nervous habits, the development of faulty moods, to reactions, such as seclusiveness and sex habits. Going back to children of the preschool age one will find an early stage of the same problem.

To deal with this wide field may seem too big a task, but with each one of these topics one can take very practical steps. In the care of incipient mental disorders there can be not only state outpatient clinics, but clinics associated with all the general hospitals and some sort of local organization through the districts whereby the average person will be assured of a fairly decent examination. Dr. Healy is showing what can be done with delinquency. For other social problems there are a great many organizations but very few have any insight into the principles of mental hygiene, and some coordinating organization is required. A central organization could teach those responsible for educating pupils the importance of these aspects of mental health, and urge that mental hygiene be taught in the normal schools. We can arrange that school physicians have some experience in the psychopathology of childhood and that school nurses have as a part of their training some experience with the same disorders. Dr. Thom at one clinic sees mothers of children of preschool age, and various minor disorders are brought to him. There are two agencies at present in the field which we ought to support vigorously: the Massachusetts Society for Mental Hygiene and the parent society, the National Committee for Mental Hygiene. The present campaign in Boston is to put the relevant data before those who are able financially to support this very important work.

RESOLUTIONS ON THE DEATH OF WALTER CHANNING, M.D., LL.D.

The following resolutions were read and adopted:

To the members of the Boston Society of Psychiatry and Neurology, both individually and collectively, the death of Dr. Walter Channing, its founder and one of its most valued members, comes with a peculiarly deep sense of loss. It is given only to men of far sight and unusual powers of mind to serve the cause of humanity as did Channing by initiating and furthering large and practical public measures for the benefit of the insane and feebleminded.

He died at his home in Brookline on Nov. 23, 1921, at the age of 72. He came of distinguished ancestry and was born in Concord, Mass. He was educated at the Chauncy Hall School and the Massachusetts Institute of Technology, and began the study of medicine at the College of Physicians and Surgeons in New York and the Harvard Medical School, later becoming an intern in the Massachusetts General Hospital. Then began his career as a practical psychiatrist by service as assistant physician in certain state hospitals. In 1879, he established his widely known and successful sanatorium in Brookline, now in Wellesley.

He was from the first a frequent contributor to medical and other journals, and became a consultant and medical expert of high repute testifying, among other prominent cases, in that of Guiteau, the slayer of President Garfield.

He was a member of the American Psychiatric and American Neurological Associations, and was the founder of the Department of Mental Diseases of the Boston Dispensary, and professor of mental diseases in Tufts Medical College, where he received the degree of LL.D. in 1900.

It was, however, in his more public work that his remarkable capacity as organizer, planner and adviser found full scope. He was foremost in setting on foot measures which resulted in the formation of the then State Board of Insanity. In securing legislation which resulted in placing the dependent insane of Boston, formerly city charges, under state care he was a large factor, and he was a powerful influence in shaping the subsequent reorganization of the Boston State Hospital. In the establishment of the Boston Psychopathic Hospital also, he was one of the prime movers. He could be relied on to inform and mold professional and public opinion in behalf of any good measure or policy, and had surprising success in turning all interests into helping to pass the laws required to meet these changes.

His great interest in all matters pertaining to the insane and feebleminded, and his unfailing zeal and persistence in every effort to promote their welfare brought him constantly during many years into close contact with state and institutional officers responsible for their supervision. His advice was most helpful and always impersonal and altruistic.

In these general relations the real Channing was not always revealed. Dr. Copp, formerly the executive officer of the Board of Insanity, writes: "I came really to know him in our more intimate relationship while he was chairman of the trustees of the Boston State Hospital, during the period of its transition from a municipal to a state institution, its reorganization in adaptation to the new status, the study of its development and especially the planning of the Boston Psychopathic Hospital. Here were revealed the sympathy, self-effacement, good judgment and unswerving adherence to right policies, principles and methods of administration which made it a joy and inspiration to work with him. His great forcefulness sometimes obscured the warmth and friendliness of his nature. It is one of the deep satisfactions of my life to have known him and enjoyed his friendship."

As a citizen, Channing was equally enterprising and valuable to the town of Brookline in promoting lasting educational improvements and public health measures.

He was a man of calm exterior but superabundant energy. Although somewhat cold and aloof in manner, he formed warm friendships and possessed a lively sense of humor. He was unusually quick to recognize and applaud worth in others whether of character or achievement, and invariably ready with active help or counsel to his fellow workers. His private charities were many. In short, it may truthfully be said of Channing that in his life and work

> ". . . he did with cheerful will
> What others talked of while their hands were still."

Henry R. Stedman,
G. Alder Blumer,
Herbert B. Howard,
Committee.

PHILADELPHIA NEUROLOGICAL SOCIETY

Regular Meeting, Jan. 27, 1922

George Wilson, M.D., *President*

SACRALIZATION OF THE FIFTH LUMBAR VERTEBRA WITH SPINAL SYMPTOMS. Dr. Albert Gordon.

Attention is called to the sacralization of the fifth lumbar vertebra as a cause of lumbosacral pain. The second ossification of the vertebrae is the direct cause of the sacralization which may appear as early as at the age of 5 or as late as at the age of 48. The clinical picture consists chiefly of pain in the lumbar region with stiffness and deviation of the spine. In a certain group of cases there is also secondary involvement of the roots and of the spinal cord.

An example of such an occurrence is presented. In addition to the pain in the back, stiffness and kyphosis, the patient has sharp pain in the lower extremities and markedly increased knee and extensor plantar reflexes. The interesting points about this case are: uneven distribution of the sacralization, more on one side than on the other; the onset of the painful phenomena at the mature age of 26; and involvement of the roots and spinal cord.

A CASE OF TABES DORSALIS WITH CHARCOT JOINTS OF THE SPINE AND MARKED WASTING OF THE MUSCLES OF THE RIGHT LEG. Dr. S. F. Gilpin.

The patient, a white man, aged 51 years, had a good family and past history, with the exception of a chancre twenty years ago. He strained his spine by lifting one year ago and attributed his present trouble to that injury. His right leg was much smaller than the left and showed marked muscular atrophy. Physical examination showed the classical signs of tabes.

The case is interesting because of the deformity of his spine and the muscular atrophy in the right leg. Roentgen-ray examination showed marked deformity of the fifth lumbar and to some extent of the fourth lumbar vertebra and apparently overproduction of bone. This is the third case of Charcot joint of the spine observed within one year. An interesting question arises as to the cause of the atrophy of the muscles of the right leg. Does he have a separate anterior horn lesion in the lumbar cord or is this overproduction of bone exerting pressure on the nerve roots?

DISCUSSION

Dr. William G. Spiller: It is noteworthy that three cases of tabes with arthropathy of the spinal column have occurred within a short time at the Jefferson Hospital. Rare cases sometimes occur within short periods of time, but it should not be thought that tabetic arthropathy of the spinal column is common. I reported a case of this kind twenty years ago (Arthropathy of the vertebral column in tabes, *American Medicine,* Nov. 1, 1902).

RAPIDLY DEVELOPING COMPLETE BLINDNESS AND DEAFNESS ACCOMPANIED BY MENTAL IMPAIRMENT PRODUCED BY BRAIN TUMOR. Patient presented by Dr. Edward A. Strecker.

A widow, 55 years old, the mother of two children, aged 29 and 30, had measles twice during childhood; smallpox at the age of 3, and scarlet fever at 18. Ten years ago a herniotomy was performed and at the same time a uterine tumor (nature unknown) was removed. The climacteric was accomplished three years ago.

About one year ago the patient began to have dizzy attacks during which she fell. At the same time she complained of pain in the eyes, and an ophthalmologist reported fairly good vision and normal eye-grounds, but thought there was incipient cataract. About six months ago the patient began to complain of dimness of vision which in two weeks progressed to absolute blindness. A month later there was difficulty in hearing and in four weeks there was complete deafness. There was no history of headache or vomiting.

Physical examination revealed total blindness. The eyes were examined by Dr. G. E. deSchweinitz and Dr. Wm. T. Shoemaker. The pupils were about 4.5 mm., stiff to light, but apparently there was no interference with the ocular movements. There was bilateral choking of the dsks, amounting to 4 or 5 diopters, the swelling beginning to subside with evidence of nerve atrophy. The patient was deaf in both ears. She did not respond to tests for smell or taste but apparently enjoyed her food. There was a weakness of the left side of the face with a questionable sensory diminution on the same side. Though it was difficult accurately to test the patient, there seemed to be a tendency to fall backward and to the left. Unfortunately, the inability of the patient to cooperate prevented satisfactory neurologic examinations.

Dr. Fisher made the following otoligc report: There was no response on the left side to douching with cold water at 68 or hot water at 114 F. There was some response on the opposite side to cold water. The neuro-otologic examination seemed to indicate involvement of the left cerebellopontile angle.

On Dec. 26, 1921, there was a convulsion, the only one which has ever occurred. Unfortunately, I did not witness this convulsion but the night nurse made the following report: "At 9 p. m. the patient was up and voided a large quantity of dark, reddish colored urine. She seemed about the same as usual excepting that she requested me to press my hands against her head as though she were having a headache. Fifteen minutes later she was found moaning and with the entire body twitching. She had turned on the right side which is unusual as she always sleeps on her back. Twitching of the arms continued, but became less marked in the legs. It was present on both sides. When the patient was turned there was projectile vomiting; the vomitus was dark brown and had an offensive odor. The pupil of the right eye was turned upward and apparently slightly to the right during the convulsion. The entire convulsion lasted twenty-five minutes." There was no previous instance of vomiting with the exception of an attack accompanied by nausea which followed an injection of morphin.

The laboratory reports showed a trace of albumin and a few hyaline and granular casts in the urine. The blood count and smear were not remarkable. The Wassermann tests of the blood and spinal fluid were negative. The direct pressure of the fluid was twice the normal; the Nonne, Noguchi and Ross-Jones tests were all four plus, and there were never more than two cells. The roentgenograms were not very satisfactory on account of the lack of cooperation of the patient; the report states that there was apparently considerable abnormality about and posterior to the sella. The anterior clinoids were very well shown, but there was no evidence of the posterior. There was considerable lack of density at the base just posterior to this area.

Before her admission to the hospital in November, 1921, the family gave the following account of her mental condition: "Three months ago her son brought a strange man to the house. The patient disliked and feared him. After he had gone, she insisted that he was still in the house and said that he beat and kicked her. She told the neighbors that her family abused her and starved her. She pounds on the walls and screams 'murder' from the windows and front porch. She is resistive, antagonistic, and stubborn and strikes at every one who goes near her; she delivers angry tirades at members of the family, and if she cannot have her own way, becomes very much excited. She is not destructive or untidy, and she has a good appetite and sleeps well. She becomes confused as to her whereabouts at times. She thought she was on the porch when she was in bed and attempted to climb the bed post. She threatened to kill herself if she were taken to a hospital; she was brought today by force." Since her admission to the hospital such marked symptoms had not been noted. It, of course, seemed difficult to estimate her mental reactions. There seemed to be confusion and at times disorientation. Occasionally she quarreled with and scolded some of the members of her family, and it is possible such conduct was dictated by the vague paranoid trend. For the last two weeks she has seemed quite dull and stupid and at times has been untidy. More recently the patient's judgment of spatial relations has been faulty. For instance, several times she apparently did not realize that her position had been changed from a sitting to a reclining one. Again she frequently complained that the position of the bed had been reversed.

DISCUSSION

Dr. T. H. Weisenburg: The symptoms presented in the patient are indicative of a cerebellar lesion which has extended into the pontile angle on both sides involving the eighth nerves on both sides, and in addition the facial nerve on the left.

The history undoubtedly points to a brain tumor as indicated by the gradual development of the choked disk with loss of vision. The involvement of both eighth nerves is shown by the gradual loss of hearing and the history of dizzy attacks, during which she fell.

My examination demonstrated that the patient had a tendency to stagger backward, chiefly to the left. There is also a weakness of the left seventh nerve. Asynergy could not be tested for in either the upper or the lower limbs, but the falling backward and to the left indicated that the asynergy was chiefly in the trunk.

It seems to me that the best explanation of the symptoms in this patient is given by a tumor in the fourth ventricle which has extended into both angles involving both eighth nerves.

About fifteen years ago, with Dr. Mills, I studied a patient with almost similar symptoms. She had disturbance and later loss of sight and hearing with involvement of the seventh nerve on both sides, instead of on one side as in this patient. She also had asynergy, chiefly of the trunk for she always staggered backward. Pathologic examination showed a tumor filling up the entire fourth ventricle in which there was extension into both cerebellopontile angles involving both seventh and eighth nerves.

Dr. John G. Wilson, Norristown: Several years ago I saw a patient who had severe headache for four or five days, with no mental symptoms, but who in the course of three or four days gradually became completely blind. Examination of the fundus showed a double choked disk, but two or three days after this she had a vomiting spell and discharged three or four ounces of pus from her nose, after which the symptoms disappeared.

Dr. Charles K. Mills: Doubtless the case just reported is one of tumor, either frontal or cerebellar, perhaps of the lower inferior surface of the cerebellum. What impressed me was that the patient not only had double choked disk, causing blindness, but that she had bilateral deafness which might possibly be due to a cause similar to that producing her blindness. Some years ago I called attention to the possibility of having what might be termed an eighth nerve or auditory choked disk. I see no reason why this might not occur when one considers the course of the eighth nerve from the cochlea and semicircular canal through the internal auditory meatus to the brain stem. An objection to the structural pathogenesis suggested by Dr. Weisenburg is that it seemed almost impossible that the tumor should extend so as to involve the tissues of the floor of the fourth ventricle and not produce other symptoms than those which were mentioned.

A STUDY OF HEREDITY IN EPILEPSY, BASED ON ONE THOUSAND FOUR HUNDRED AND FORTY-NINE CASES. Dr. C. W. Burr.

This paper will be published in full in a future number of the Archives of Neurology and Psychiatry.

DISCUSSION

Dr. J. Hendrie Lloyd: The subject of heredity is so much involved that we ought to recognize the fact that we cannot know much about it in reference to disease. The study of heredity through one or two generations does not really throw much light on it; I think this is proved by a simple consideration of the mendelian laws. What can we tell about heredity? There is probably not a man in the room who knows accurately the diseases that his four grandparents died of. Now when we go back to the generation before that, the great grandparents, we are in absolute ignorance. If you multiply every generation by two, as you must—for every man has two parents, four grandparents, eight great grandparents, sixteen great, great grandparents and so on—by the time you have gone back twenty generations you have had one million ancestors. You can take a lead pencil and figure this out for yourselves. How is it possible in that vast sum of ancestors, who have disappeared into the empyrean, to tell what diseases they had?—gout, rheumatism, syphilis, epilepsy, insanity, alcoholism, tuberculosis, cancer and what not? If they had transmitted their diseases to their descendants how would it be possible for any of us to be alive? There is something in the whole subject that escapes us. We must have some ability to throw off these inherited traits from our ancestors, possibly by a process of natural selection in the chromosomes. It is a struggle for existence. I agree with Dr. Burr in regard to syphilis. This is not a hereditary disease; it is a congenital disease. Heredity is only that which is transmitted through the germ plasma. Syphilis is transmitted by a spirochete. Even if it got into an ovum, this would not be an instance of hereditary disease, but an evidence of transmitting a disease from the mother to the ovum, by a spirochete. But it is doubtful whether an ovum thus invaded could develop. David Starr Jordan has recently written a paper on heredity in which he attempts to prove that there are probably several million people now living who are descended from the Emperor Charlemagne. He went to the extent of giving the geneologies of Abraham Lincoln, of Grover Cleveland and Theodore Roosevelt, as descendants of Charlemagne. I would not be surprised if many in this room were descendants of Charlemagne. If Charlemagne could transmit by simple arithmetical progression in every generation, there had been time for him to have twenty million descendants. This seems like a reductio ad absurdum, but it illustrates the difficulties of the problem.

Dr. Charles S. Potts: Dr. Burr's paper is a good presentation of the subject. I was glad to hear what Dr. Burr has said about the influence of alcohol in the parents as a cause of epilepsy. Several years ago the idea occurred to me that if half that was blamed on alcohol were true, considering the alcoholic habits of our ancestors, a great majority of us should be either epileptic or imbeciles.

A CASE OF UNILATERAL OPTIC ATROPHY AND CONTRALATERAL HEMIPLEGIA RESULTING FROM OCCLUSION OF THE CEREBRAL VESSELS. Dr. N. W. Winkelman.

On July 1, 1921, a white man, aged 61 years, whose family history was negative, suddenly dropped to the floor unconscious. He was in bed three weeks and during this time he could not talk and could not move the right side of his body, including the face. His wife noticed that his left eye was turned outward. Since that time he had made slight improvement, and he soon found that his left eye was completely blind, a condition which he is absolutely sure was not present prior to his "stroke." He is now motor aphasic, and walks with a distinctly right hemiplegic gait. He shows marked arteriosclerosis. His pupils are irregular; the right reacts quickly but the left is stationary to light, though the consensual light reaction is retained. There is absolute blindness in the left eye. He is able to read words and letters of large size. The reflexes on the right are exaggerated, with the Babinski sign and ankle clonus present. There is no loss of stereognosis. He is able to obey simple commands, though there is definite lack of ability to carry out complicated commands. His memory is much impaired, but he is able to find his way around the neighborhood. The eye report by Dr. Langdon is as follows: "The upper branch of the central artery of the left eye is patulous but is very irregular in caliber. The inferior branch is nothing but a glistening fibrous band, apparently without blood in it."

The diagnosis, therefore, is an incomplete obstruction of the left internal carotid artery at the point where the ophthalmic artery is given off and occluding that artery also.

DISCUSSION

Dr. W. B. Cadwalader: In 1912 I presented a patient before this Society with unilateral optic atrophy and contralateral hemiplegia with aphasia caused by occlusion of certain cerebral vessels. So far as I know, Dr. Winkelman's case is only the second one ever recorded in this country and the condition, therefore, must be exceedingly rare. It can be easily explained by assuming that an embolism has separated, one portion passing into the ophthalmic vessel or into the central artery of the retina producing optic atrophy secondarily on the same side, and another portion being carried into the middle cerebral vessel of the same side, causing softening of the brain that produced aphasia and hemiplegia on the opposite side of the body. That an embolism can be divided into two portions and occlude two separate cerebral vessels simultaneously might seem to be far-fetched. However, this was actually found at postmortem examination in such a case by Growers, of London, to which Dr. Winkelman will refer in the report on his patient.

AN EPILEPTIC WOMAN AND HER SIXTEEN CHILDREN.

This paper was read by Dr. N. S. Yawger.

Book Reviews

LE REFLEX PILOMOTEUR. ETUDE ANATOMO-CLINIQUE SUR LE SYSTEME SYMPATHIQUE. Avec 74 Figures et 12 Planches En Noir Et En Couleurs. André-Thomas Médecin de l'Hôpital Saint-Joseph, Vice-président de la Société de Biologie. Pp. 242. Price, 25 francs. Paris: Masson et Cie, 1921.

During the war Dr. André-Thomas examined many wounded soldiers suffering from lesions of the spinal cord and other parts of the nervous system and in these cases studied the pilomotor reflexes. In order properly to interpret such clinical observations it is necessary to have a clear conception of the anatomy and physiology of the sympathetic nervous system and particularly of the arrangement of the neurons which innervate the smooth muscle of the hair follicles. The first chapter of the book is devoted to such fundamental considerations as the following: the smooth muscle of the skin, the anatomy of the sympathetic nervous system, the histology of the sympathetic ganglions, the visceral efferent cell column of the spinal cord, and the physiology of the pilomotor reactions; and presents a good summary of existing information on the topics treated. On disputed points the author follows closely the work of Cajal and Langley and gives in some detail the results of the latter investigator's epoch making study of the pilomotor innervation in the cat.

In the second chapter the author deals with the pilomotor reflexes in man and with the technic of eliciting them. Cold was found to be the most effective stimulus, though heat, electricity and mechanical stimuli also were effective. Tickling or rubbing the hand lightly over the skin or firmly grasping the skin and underlying muscles are efficient mechanical stimuli. When the excitation is unilateral the pilomotor reflex is unilateral. After tickling or pinching the nape of the neck, goose flesh appears over the corresponding half of the body. The superior part of the body reacts first, the phenomenon extending to the lower part of the trunk and the inferior extremity. If the reflex is ephemeral, the reaction may have disappeared from the arms and upper part of the body when at its height over the lower part of the trunk and the leg. Since the response is least easily evoked in the skin of the head and neck, it may be necessary to prolong and reinforce the stimulus in order to make sure that these parts will participate. When the excitation is bilateral and symmetrical the reaction is also bilaterally symmetrical.

In sensitive persons an undiminished reflex may be obtained many times with the same stimulus. But often after two or three trials the reaction becomes feeble or entirely fails to appear. Light stimuli do not always provoke a complete unilateral reflex. Stroking the skin of the thorax may cause a reaction limited to that side of the thorax and the corresponding arm. In the same way stroking the abdominal wall below the umbilicus may cause a reaction over that side of the abdomen and the corresponding leg.

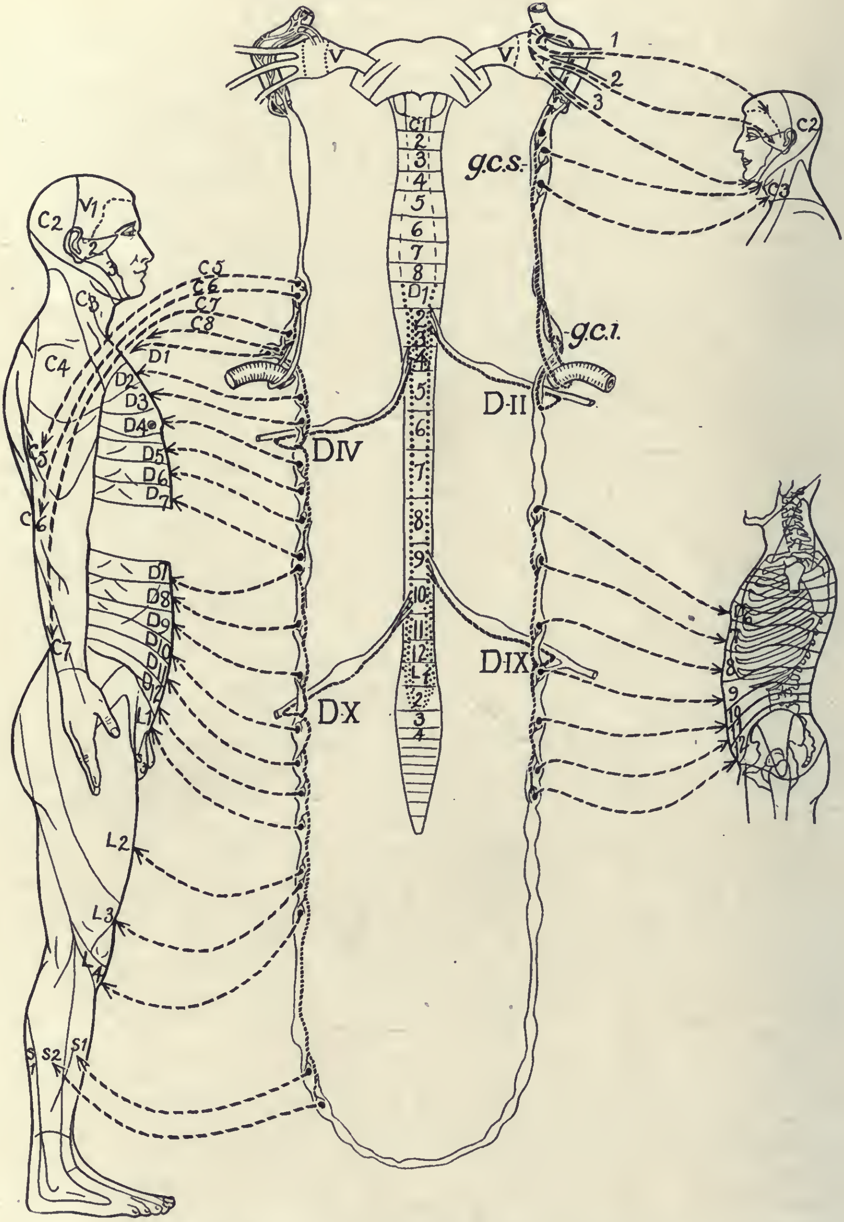
In Chapter 3 are presented the results of examination of wounded soldiers with transverse lesions of the spinal cord. It contains reports of twenty-nine cases in which he was able to check his clinical observations against the findings at necropsy and of twenty-three more in which the data are purely clinical. These observations constitute an important addition not only to clinical neurology but also to the anatomy and physiology of the sympathetic system and furnish data by the use of which the author has been able to construct a scheme of the arrangement of the pilomotor neurons in man.

Chapter 4 is devoted to a systematic examination and interpretation of the observations presented in the preceding chapter. The conclusions reached from the study of patients with transverse lesions of the cord are in close agreement with those of Langley. That investigator stimulated the ventral roots of each of the spinal nerves in the cat and noted the extent of the resulting pilomotor response. André-Thomas noted the level at which the pilomotor reflex was interrupted by transverse lesions of the spinal cord. His conclusions concerning the distribution of the pilomotor neurons in man are summarized in the accompanying table. In order to make the significance of this table clear we also reproduce in simplified form an illuminating diagram illustrating the course and distribution of the pilomotor fibers originating in the second, fourth, ninth and tenth thoracic segments of the spinal cord.

Like other visceromotor fibers of the thoracicolumbar outflow the preganglionic pilomotor fibers take origin from the intermediolateral cell column of the thoracic and first two lumbar segments of the spinal cord. They run through the ventral roots and white rami to the sympathetic trunk within which they run up or down for varying distances and end within the ganglions of the trunk. The fibers from a given spinal cord segment are distributed to several segmental sympathetic ganglions. (The superior cervical, *g.c.s.*, and inferior cervical ganglions, *g.c.i.*, each represent several segmental ganglions fused together.) Within the ganglions of the sympathetic trunk the preganglionic fibers enter into synaptic relations with postganglionic neurons. The fibers arising from these neurons of the second order relay the impulses to the smooth muscle of the hair follicles. They run from the segmental sympathetic ganglions by way of the gray rami communicantes to the spinal nerves of the corresponding segment and are distributed through these nerves to the respective dermatomes. For example, the preganglionic pilomotor fibers from the first three thoracic segments of the cord run upward in the sympathetic trunk to the superior cervical sympathetic ganglion, whence the impulses which they carry are relayed by postganglionic fibers along the trigeminal and second and third cervical nerves to the skin of the head and neck.

Transverse section of the spinal cord arrests the transmission of impulses within the cord from segments above to segments below the lesion and vice versa. Stimulation of the skin above the line of anesthesia causes erection of the hairs in the dermatomes receiving pilomotor impulses from the segments of the cord above the lesion. Because these cord segments are still under the influence of the brain the author designates these reactions as encephalic reflexes.

Some time, varying from several days to a few weeks after the injury, the segments of the spinal cord below the lesion take on a new activity independent of the higher centers; that is, they show spinal automatism. The pilomotor responses, which can then be obtained by stimulating the skin below the line of anesthesia and which must be mediated entirely by those segments of the spinal cord which are cut off from the brain, are designated as spinal reflexes. These spinal pilomotor reflexes are of value in fixing the extent and lower limit of the lesion. The upper limit of the lesion is of course determined by the line of anesthesia and the muscles which are paralyzed. Knowing the dermatomes which are supplied with pilomotor fibers by the various segments of the cord it is possible to form an idea of the lower limit of the lesion by determining the highest dermatome included in the spinal pilomotor reflex.



Course and distribution of the pilomotor fibers originating in the second, fourth, ninth and tenth thoracic segments of the spinal cord.

A few illustrative cases may be cited to show the limits of the skin areas supplied by certain spinal cord segments. A soldier with a complete transverse lesion in the third and fourth spinal cord segments showed an encephalic reflex limited to the face and neck. No response occurred below the cutaneous area supplied by the third cervical nerve. This dermatome, then, represents the lower limit of pilomotor innervation from the second thoracic segment of the cord (D II). In another case with destruction of the fourth thoracic segment an appropriate stimulus applied above the line of anesthesia caused goose flesh to appear over the area on the shoulder supplied by the fourth cervical nerve. In still another case the fifth and sixth segments were destroyed. but the encephalic reflex covered the entire arm and the thorax to the level of the costal arch. From these last two cases it is clear that the fourth thoracic segment must supply the dermatomes from the fifth cervical to the seventh thoracic inclusive (D IV).

GANGLIONS OF THE SYMPATHETIC TRUNK *

Segments of Spinal Cord			Dorsal												Lumbar					Sacral					Coccygeal
I	g.c.s.																								
II	g.c.s.																								
III	g.c.s.																								
IV	g.c.s.	g.c.i.	1	2	3	4	5	6																	
V	.....	g.c.i.	1	2	3	4	5	6	7	8?															
VI	.....	g.c.i.	1	2	3	4	5	6	7	8	9?														
VII	.....	g.c.i.	1	2	3	4	5	6	7	8	9	10?													
VIII							5	6	7	8	9	10	11												
IX								6	7	8	9	10	11	12	1										
X									7	8	9	10	11	12	1	2	3	4	5	1	2				
XI										8	9	10	11	12	1	2	3	4	5	1	2	3	4	5	
XII											9	10	11	12	1	2	3	4	5	1	2	3	4	5	1
I												10	11	12	1	2	3	4	5	1	2	3	4	5	1
II													11	12	1	2	3	4	5	1	2	3	4	5	1

* This table shows the ganglions of the sympathetic trunk in which the preganglionic pilomotor fibers arising from the various segments of the spinal cord terminate. Each of these ganglions sends postganglionic pilomotor fibers to the corresponding dermatome; g.c.s., superior cervical ganglion; g.c.i., inferior cervical ganglion.

In a number of patients in whom the lesion was situated just below the tenth dorsal segment the encephalic reflex covered the entire lower extremity. The upper limit of pilomotor supply from the tenth thoracic segment is given by a case in which the seventh, eighth and ninth thoracic segments were destroyed but in which a stimulus below the line of anesthesia produced a spinal pilomotor reflex extending upward to the seventh thoracic dermatome. From these facts the author concludes that the tenth thoracic segment supplies pilomotor innervation to the skin of the abdomen and lower extremity; that is, to the dermatomes from the seventh thoracic to the second sacral inclusive (D X).

Chapter 5 is devoted to the pilomotor reflexes in such diseases of the spinal cord as transverse myelitis, pachymeningitis, anterior poliomyelitis and syringomyelia.

Chapter 6 deals with the pilomotor reflexes in cases of lesions of the peripheral nerves. If a nerve is injured distal to the point where it receives the fibers of the gray rami communicantes, the smooth muscles of the hair follicles are paralyzed in the cutaneous area supplied by that nerve. If, however, the nerve roots going to form the brachial or lumbosacral plexuses are destroyed within the spinal canal or intervertebral foramina, the pilomotor reactions will not be affected because at this point the roots contain no pilomotor fibers. The presence or absence of pilomotor reactions in the areas of anesthesia resulting from injuries to the roots of the brachial and lumbosacral plexuses is therefore a matter of considerable diagnostic importance in determining the location of the lesion.

In Chapter 7 there are recorded five cases of lesions involving the sympathetic trunk. The symptoms were such as might be inferred from the anatomic course of the pilomotor fibers. Chapter 8 deals with the pilomotor reflexes in patients with brain lesions and in the insane; Chapter 9 with the effect of skin diseases on these reflexes; and Chapter 10 with the exaggeration of these reflexes caused by irritative lesions. The book ends with an account of the nature of the encephalic reflex.

The entire work, with the exception of the introductory chapter, rests on observations made by the author. It covers an entirely new field and contains many new facts some of which may prove to be of considerable clinical importance.

S. W. Ranson.

THE ANATOMY OF THE NERVOUS SYSTEM FROM THE STANDPOINT OF DEVELOPMENT AND FUNCTION. By Stephen Walter Ranson, M.D., Ph.D., Professor of Anatomy in Northwestern University Medical School, Chicago. Cloth. Price, $6.50. Pp. 395, with 260 illustrations. Philadelphia: W. B. Saunders Company, 1920.

In this book an excellent presentation is made of the anatomy of the nervous system. The first two chapters are devoted to the origins and functions of the nervous system and the neural tube and its derivatives. The third chapter is concerned with the histogenesis; the fourth with the neurons and neuron chains; the fifth with spinal nerves. From here the various parts of the nervous system, beginning with the spinal cord, are discussed in order.

The manner of discussion is different from that found in the usual anatomy in the sense that the functions of the parts are given in correlation with the anatomic data. This is the logical method of teaching the student anatomy and physiology and is admirably worked out. The physiology in comparison has naturally received only scant attention, but it is given in sufficient detail for the student.

It is difficult to review the various chapters, but there are many features in this work which are not present elsewhere. The book has been so arranged as to facilitate comparative studies of the head of the shark and the brain of the sheep which, as the author points out, are used in many laboratories. Besides, there is an outline for a course in neuro-anatomy.

The illustrations are excellent, many of them original; for example, the dissections of the internal capsule, the corona radiata and the thalamic radiation to the temporal lobe which are the result of the so-called mechanical dissociation, for it has been found that in formaldehyd hardened material bundles of fibers can be followed with ease and the outline of nuclear masses readily determined. The author has already described these dissections in a contribution in the ARCHIVES OF NEUROLOGY AND PSYCHIATRY (Description of Some Dissections of the Internal Capsule, the Corona Radiata and the Thalamic Radiation to the Temporal Lobe **5**:361 [April] 1921).

The manner of the discussion of subjects is very well thought out. For example, in the chapter on the cerebellum there are given in order the development, gross anatomy, morphology, functional localization, the finer anatomy and connections of the cerebellum with the rest of the brain, and finally the histology.

Perhaps some criticism could be directed to the chapter on cortical or cerebral localization. While motor localization is properly stated, nevertheless in one of the succeeding chapters, on page 317, an old illustration by Starr is used, indicating the motor centers, especially in their lower portion, as being partly in the postcentral convolution. Perhaps a better choice of illustration can be made in a subsequent edition. In discussing the visual receptive centers on page 292, the modern conception of the visual localization, as developed by the war literature, has not been taken advantage of. The old classical idea of aphasia is adhered to. It is wise as the author states not to discuss any controversial parts in a book of this sort.

With the exception of these few points, nothing but praise can be given the book. The publishers have done their work well—the paper is good, the text clear and not at all tiresome to the reader. The book can be recommended for the student in anatomy.

FOUNDATIONS OF PSYCHIATRY. By WILLIAM A. WHITE, M.D., with an Introduction by DR. STEWART PATON. Pp. 134. New York and Washington: Nervous and Mental Disease Monograph Series No. 32. Nervous and Mental Disease Publishing Company.

Within the space of this small volume Dr. White has essayed "to formulate a Philosophy of Psychiatry." He discusses the evolution of the psyche, the integration, dynamics and stratification of the organism; psychopathology, the nature of the neuroses and psychoses and the application of the principles formulated to therapy and social organization. Necessarily these are presented in greatly condensed form, and the language is highly technical and often without definition. It is therefore necessary for the reader to possess a fairly intimate acquaintance with the subject.

The earlier chapters are devoted to the concept of psychiatry as the study of "What is the man doing?" With admirable illustrative examples and many well selected quotations from contemporary literature it is shown that man is an integration and not merely the sum of the various organs of which he is built. What he does is a problem of relations between the needs or desires inherent in him as a living organism and the conditions under which he must satisfy those needs. In other words, it is a dynamic or action and reaction (ambivalent) relation, the desire or "wish" being the unit of activity. Instead of sensations which constitute the unit of formal descriptive psychology, affects, representing the cravings of various autonomic segments, are the fundamental motives of behavioristic psychology. Interesting comparisons are made between affect and intellect on the one hand and protopathic and epicritic sensibility on the other. Conditioned reflexes are mentioned incidentally but are not used by the author to any extent in the development of his subject.

The later chapters of the book are practically a résumé of the views of the psychanalytic schools, and a concise description and comparison is given of the views of Janet, Freud, Jung, Adler and Kempf. No allusion is made to the studies of the neuroses which arose during the war. White carries this discussion even into the rôle of psychologic mechanisms in the etiology of many chronic diseases and the "problem why certain etiological factors, for instance, the tubercle bacillus, should attack the lung in one person, the kidney in another, etc." That a study of the personality in any form of disease is essential to the adequate treatment of the man diseased will be conceded by all, but this concerns the practice rather than the foundations of psychiatry.

The keynote of the work, however, is the recognition of the man as a personality, an integrated organism struggling for satisfaction in a social milieu which is itself an integration and not a mere collection of individuals. For this reason the book is worth reading, although it cannot be recommended for the use of students about to begin the study of psychiatry.

ELEMENTS DE PATHOLOGIE MENTALE CLINIQUE ET MEDECINE LEGALE. Par R. Benon, Ancien Interne de la Clinique de Pathologie Mentale et des Maladies de l'Encephale de la Faculté de Médecine de Paris; Médecin du Quartier des Maladies Mentales de l'Hospice Général de Nantes. Avec Préface de M. Balthazard, Professeur de Médecine légale a la Faculté de Médecine de Paris, Membre de l'Académie. Price, 6 francs. Pp. 242. Paris: Librairie Octave Doin, Gaston Doin, Editeur, 8 Place de L'Odéon, 1922.

This is an excellent example of the small elementary medical guides of which the French seem to be fond. Like many of the others it is bound in paper and rather poorly printed on poor paper. But the matter is good.

The work is essentially clinical, based on the author's experience as a teacher, and obviously designed for the beginner. It begins by defining the current terms of psychiatry and then presents mental disorders in symptom groups —a very good method of approach for a book of this kind, for after all it is a group of symptoms which the patient presents to the physician. First, delirium is considered, then dementia, then mania, etc. The symptom is defined, explained and its clinical application presented. The author has attained his desire to present his matter simply, clearly and with precision.

While this little manual can in no wise be considered a medical textbook except as introductory to some more complete work, we know of nothing which would be more satisfactory for the instruction of the more intelligent attendants in hospitals and sanatoriums for the insane.

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AN ESSAY ON THE SHAKING PALSY, BY JAMES PARKINSON, M.D., MEMBER OF THE ROYAL COLLEGE OF SURGEONS *

WITH A BIBLIOGRAPHIC NOTE THEREON BY

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L.R.C.P. (London)
Surgeon (R.), U. S. P. H. S.
PHILADELPHIA

A good many years ago my interest in the history of this book was aroused by K. Mendel's statement in his monograph on paralysis agitans to the effect that, notwithstanding his thorough search through the libraries of the German universities, as well as through the Royal Library, and through the larger English libraries, he did not succeed in finding one copy of Parkinson's original description of the disease contained in an octavo booklet, entitled "An Essay on the Shaking Palsy," published in 1817 by Sherwood, Nelly & Jones, London.

Charcot in his twentieth "Leçon de Mardi," given on June 12, 1888, in his clinic at La Salpetrière, said that it was only after a long search that he was able, through the kindness of the librarian of the University of Manchester, to see and read a copy of this little book. On that morning he advised his students to translate the work into French on account of the excellent description of the disease contained therein.

Erich Ebstein, in a bibliographic note contained in the Feb. 15, 1912, number of the *Neurologisches Centralblatt,* calls attention to the fact that Charcot did not own a copy, as it was never found in his library, and that there was not a copy in the Paris Academy of Medicine, and none in the Bibliothèque Nationale. Ebstein further states that there are only four copies known to exist—one in the Surgeon-General's Library, Washington, D. C.; one in the Library of the Royal College of Physicians, Edinburgh; one in the Library of the Manchester Medical Society, Manchester, and one in the Library of the

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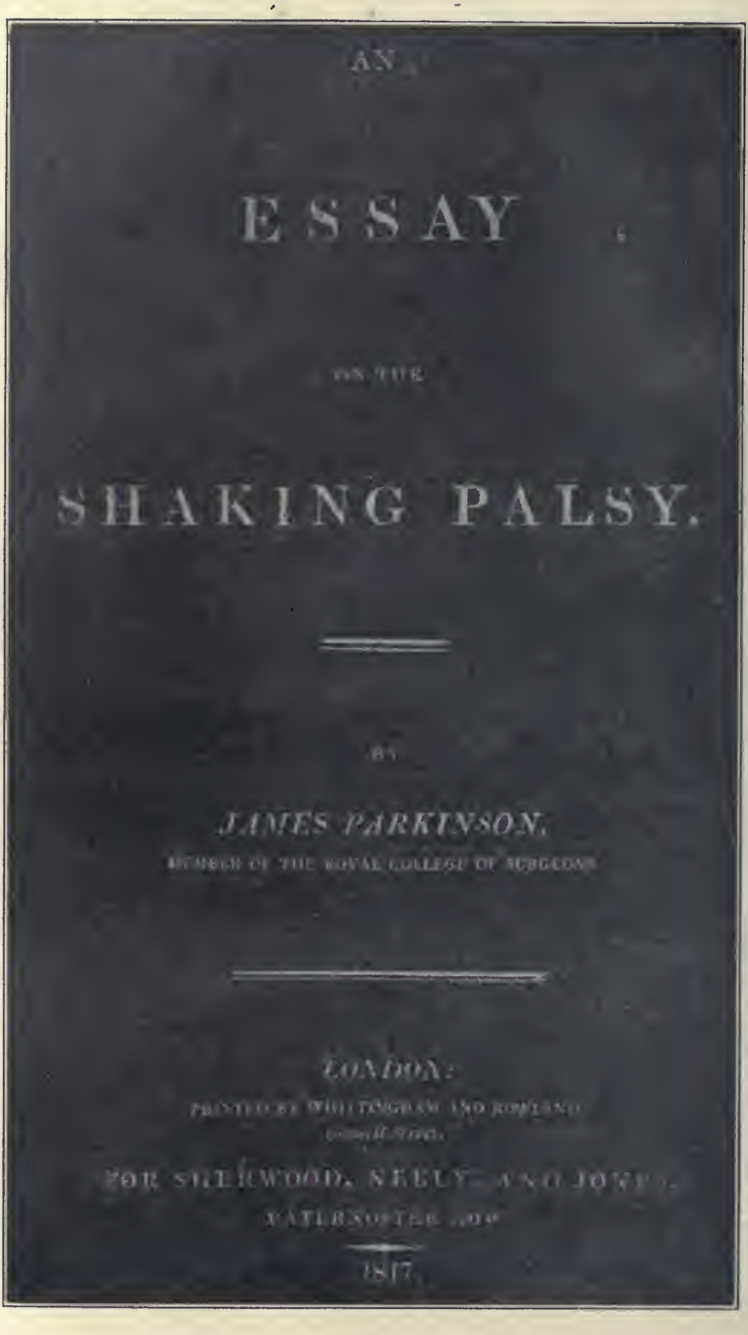
* Photostat copy obtained from the Library of the Surgeon General, Washington, D. C.



AN

ESSAY

ON THE

SHAKING PALSY.

BY

JAMES PARKINSON,

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Royal College of Surgeons, London. (Thus it is seen that Mendel's search could not have been very thorough, notwithstanding his statement.)

I have accidentally discovered that there is at least one more copy in existence, namely, the one in the private library of Dr. Sydney Kuh of Chicago. Although not one of Charcot's students took his advice about translating the booklet, a German named Willige did, and Barth of Leipzig published the translation in 1912, of course in German, as a part of Sudhoff's "Medical Classics."

It has thus come about that while German medical students and practitioners have easy access to this classic work, American and English students have up to the present time never been able to enjoy the esthetic pleasure of, nor to obtain the instruction to be gleaned from, the exact words of the original describer of the disease.

Charcot calls attention to the excellence of Parkinson's description, which, he says, covers the great majority of the cases, and must, if for no other reason, always be considered as one of the best because it was the very first.

I would like to quote the first definition of the disease: "Shaking Palsy (*Paralysis Agitans*). Involuntary tremulous motion, with lessened muscular power, in parts not in action and even when supported; with a propensity to bend the trunk forwards, and to pass from a walking to a running pace; the senses and intellects being uninjured."

Now, more than 100 years after Parkinson's time, the opportunity has presented itself to reprint his original description, so that American and English students and practitioners may henceforth have easy access to this historic classic of medical literature.

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PREFACE.

The advantages which have been derived from the caution with which hypothetical statements are admitted, are in no instance more obvious than in those sciences which more particularly belong to the healing art. It therefore is necessary, that some conciliatory explanation should be offered for the present publication: in which, it is acknowledged, that mere conjecture takes the place of experiment; and, that analogy is the substitute for anatomical examination, the only sure foundation for pathological knowledge.

When, however, the nature of the subject, and the circumstances under which it has been here taken up, are considered, it is hoped that the offering of the following pages to the attention of the medical public, will not be severely censured. The disease, respecting which the present inquiry is made, is of a nature highly afflictive. Notwithstanding which, it has not yet obtained a place in the classification of nosologists; some have regarded its characteristic symptoms as distinct and different diseases, and others have given its name to diseases differing essentially from it; whilst the unhappy sufferer has considered it as an evil, from the domination of which he had no prospect of escape.

The disease is of long duration: to connect, therefore, the symptoms which occur in its later stages with those which mark its commencement, requires a continuance of observation of the same case, or at least a correct history of its symptoms, even for several years. Of both these advantages the writer has had the opportunities of availing himself; and has hence been led particularly to observe several other cases in which the disease existed in different stages of its progress. By these repeated observations, he hoped that he had been led to a probable conjecture as to the nature of the malady, and that analogy had suggested such means as might be productive of relief, and perhaps even of cure, if employed before the disease had been too long established. He therefore considered it to be a duty to submit his opinions to the examination of others, even in their present state of immaturity and imperfection.

To delay their publication did not, indeed, appear to be warrantable. The disease had escaped particular notice; and the task of ascertaining its nature and cause by anatomical investigation, did not seem likely to be taken up by those who, from their abilities and opportunities, were most likely to accomplish it. That these friends to humanity and medical science, who have already unveiled to us many of the morbid processes by which health and life is abridged, might be excited to extend their researches to this malady, was much desired; and it was hoped, that this might be procured by the publication of these remarks.

Should the necessary information be thus obtained, the writer will repine at no censure which the precipitate publication of mere conjectural suggestions may incur; but shall think himself fully rewarded by having excited the attention of those, who may point out the most appropriate means of relieving a tedious and most distressing malady.

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AN
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CHAPTER I.

DEFINITION—HISTORY—ILLUSTRATIVE CASES.

SHAKING PALSY. (*Paralysis Agitans.*)

Involuntary tremulous motion, with lessened muscular power, in parts not in action and even when supported; with a propensity to bend the trunk forwards, and to pass from a walking to a running pace: the senses and intellects being uninjured.

The term Shaking Palsy has been vaguely employed by medical writers in general. By some it has been used to designate ordinary cases of Palsy, in which some slight tremblings have occurred; whilst by others it has been applied to certain anomalous affections, not belonging to Palsy.

The shaking of the limbs belonging to this disease was particularly noticed, as will be seen when treating of the symptoms, by Galen, who marked its peculiar character by an appropriate term. The same symptom, it will also be seen, was accurately treated of by Sylvius de la Boe. Juncker also seems to have referred to this symptom: having divided tremor into active and passive, he says of the latter, "ad affectus semiparalyticos pertinent; de qualibus hic agimus, quique *tremores paralytoidei* vocantur." Tremor has been adopted, as a genus, by almost every nosologist; but always unmarked, in their several definitions, by such characters as would embrace this disease. The celebrated Cullen, with his accustomed accuracy observes, "Tremorem, utpote semper symptomaticum, in numerum generum recipere nollem; species autem a Sauvagesio recensitas, prout mihi vel astheniæ vel paralysios, vel convulsionis symptomata esse videntur, his subjungam.* Tremor can indeed only be considered as a symptom, although several species of it must be admitted. In the present instance, the agitation produced by the peculiar species of tremor, which here occurs, is chosen to furnish the epithet by which this species of Palsy, may be distinguished.

HISTORY.

So slight and nearly imperceptible are the first inroads of this malady, and so extremely slow is its progress, that it rarely happens, that the patient can form any recollection of the precise period of its commencement. The first symptoms perceived are, a slight sense of weakness, with a proneness to trembling in some particular part; sometimes in the head, but most commonly in one of the hands and arms. These symptoms gradually increase in the part first affected; and at an uncertain period, but seldom in less than twelvemonths or more, the morbid influence is felt in some other part. Thus assuming one of the hands and arms to be first attacked, the other at this period becomes similarly affected. After a few more months the patient is found to be less strict than usual in preserving an upright posture: this being most observable whilst walking, but sometimes whilst sitting or standing. Sometime after the appearance of this symptom, and during its slow increase, one of the legs is discovered slightly to tremble, and is also found to suffer fatigue sooner than the leg of the other side: and in a few months this limb becomes agitated by similar tremblings and suffers a similar loss of power.

Hitherto the patient will have experienced but little inconvenience; and befriended by the strong influence of habitual endurance, would perhaps seldom think of his being the subject of disease, except when reminded of it by the unsteadiness of his hand, whilst writing or employing himself in any nicer kind of manipulation. But as the disease proceeds, similar employments are accomplished with considerable difficulty, the hand failing to answer with exactness to the dictates of the will. Walking becomes a task which cannot be performed without considerable attention. The legs are not raised to that height, or with that promptitude which the will directs, so that the utmost care is necessary to prevent frequent falls.

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* Synopsis Nosologiæ Methodicæ.—Tom. ii. p. 195.

At this period the patient experiences much inconvenience, which unhappily is found daily to increase. The submission of the limbs to the directions of the will can hardly ever be obtained in the performance of the most ordinary offices of life. The fingers cannot be disposed of in the proposed directions, and applied with certainty to any proposed point. As time and the disease proceed, difficulties increase: writing can now be hardly at all accomplished; and reading, from the tremulous motion, is accomplished with some difficulty. Whilst at meals the fork not being duly directed frequently fails to raise the morsel from the plate: which, when seized, is with much difficulty conveyed to the mouth. At this period the patient seldom experiences a suspension of the agitation of his limbs. Commencing for instance in one arm, the wearisome agitation is borne until beyond sufferance, when by suddenly changing the posture it is for a time stopped in that limb, to commence, generally, in less than a minute in one of the legs, or in the arm of the other side. Harassed by this tormenting round, the patient has recourse to walking, a mode of exercise to which the sufferers from this malady are in general partial; owing to their attention being thereby somewhat diverted from their unpleasant feelings, by the care and exertion required to ensure its safe performance.

But as the malady proceeds, even this temporary mitigation of suffering from the agitation of the limbs is denied. The propensity to lean forward becomes invincible, and the patient is thereby forced to step on the toes and fore part of the feet, whilst the upper part of the body is thrown so far forward as to render it difficult to avoid falling on the face. In some cases, when this state of the malady is attained, the patient can no longer exercise himself by walking in his usual manner, but is thrown on the toes and forepart of the feet; being, at the same time, irresistibly impelled to take much quicker and shorter steps, and thereby to adopt unwillingly a running pace. In some cases it is found necessary entirely to substitute running for walking; since otherwise the patient, on proceeding only a very few paces, would inevitably fall.

In this stage, the sleep becomes much disturbed. The tremulous motion of the limbs occur during sleep, and augment until they awaken the patient, and frequently with much agitation and alarm. The power of conveying the food to the mouth is at length so much impeded that he is obliged to consent to be fed by others. The bowels, which had been all along torpid, now, in most cases, demand stimulating medicines of very considerable power: the expulsion of the fæces from the rectum sometimes requiring mechanical aid. As the disease proceeds towards its last stage, the trunk is almost permanently bowed, the muscular power is more decidedly diminished, and the tremulous agitation becomes violent. The patient walks now with great difficulty, and unable any longer to support himself with his stick, he dares not venture on this exercise, unless assisted by an attendant, who walking backwards before him, prevents his falling forwards, by the pressure of his hands against the fore part of his shoulders. His words are now scarcely intelligible; and he is not only no longer able to feed himself, but when the food is conveyed to the mouth, so much are the actions of the muscles of the tongue, pharynx, &c. impeded by impaired action and perpetual agitation, that the food is with difficulty retained in the mouth until masticated; and then as difficultly swallowed. Now also, from the same cause, another very unpleasant circumstance occurs: the saliva fails of being directed to the back part of the fauces, and hence is continually draining from the mouth, mixed with the particles of food, which he is no longer able to clear from the inside of the mouth.

As the debility increases and the influence of the will over the muscles fades away, the tremulous agitation becomes more vehement. It now seldom leaves him for a moment; but even when exhausted nature seizes a small portion of sleep, the motion becomes so violent as not only to shake the bed-hangings, but even the floor and sashes of the room. The chin is now almost immoveably bent down upon the sternum. The slops with which he is attempted to be fed, with the saliva, are continually trickling from the mouth. The power of articulation is lost. The urine and fæces are passed involuntarily; and at the last, constant sleepiness, with slight delirium, and other marks of extreme exhaustion, announce the wished-for release.

CASE I.

Almost every circumstance noted in the preceding description, was observed in a case which occurred several years back, and which from the particular symptoms which manifested themselves in its progress; from the little knowledge of its nature, acknowledged to be possessed by the physician who attended; and from the mode of its termination; excited an eager wish to acquire some further knowledge of its nature and cause.

The subject of this case was a man rather more than fifty years of age, who had industriously followed the business of a gardener, leading a life of remarkable temperance and sobriety. The commencement of the malady was first manifested by a slight trembling of the left hand and arm, a circumstance which he was disposed to attribute to his having been engaged for several days in a kind of employment requiring considerable exertion of that limb. Although repeatedly questioned, he could recollect no other circumstance which he could consider as having been likely to have occasioned his malady. He had not suffered much from Rheumatism, or been subject to pains of the head, or had ever experienced any sudden seizure which could be referred to apoplexy or hemiplegia. In this case, every circumstance occurred which has been mentioned in the preceding history.

CASE II.

The subject of the case which was next noticed was casually met with in the street. It was a man sixty-two years of age; the greater part of whose life had been spent as an attendant at a magistrate's office. He had suffered from the disease about eight or ten years. All the extremities were considerably agitated, the speech was very much interrupted, and the body much bowed and shaken. He walked almost entirely on the fore part of his feet, and would have fallen every step if he had not been supported by his stick. He described the disease as having come on very gradually, and as being, according to his full assurance, the consequence of considerable irregularities in his mode of living, and particularly of indulgence in spirituous liquors. He was the inmate of a poor-house of a distant parish, and being fully assured of the incurable nature of his complaint, declined making any attempts for relief.

CASE III.

The next case was also noticed casually in the street. The subject of it was a man of about sixty-five years of age, of a remarkable athletic frame. The agitation of the limbs, and indeed of the head and of the whole body, was too vehement to allow it to be designated as trembling. He was entirely unable to walk; the body being so bowed, and the head thrown so forward, as to oblige him to go on a continued run, and to employ his stick every five or six steps to force him more into an upright posture, by projecting the point of it with great force against the pavement. He stated, that he had been a sailor, and attributed his complaints to having been for several months confined in a Spanish prison, where he had, during the whole period of his confinement, lain upon the bare damp earth. The disease had here continued so long, and made such a progress, as to afford little or no prospect of relief. He besides was a poor mendicant, requiring as well as the means of medical experiment, those collateral aids which he could only obtain in an hospital. He was therefore recommended to make trial if any relief could, in that mode, be yielded him. The poor man, however, appeared to be by no means disposed to make the experiment.

Case IV.

The next case which presented itself was that of a gentleman about fifty-five years, who had first experienced the trembling of the arms about five years before. His application was on account of a considerable degree of inflammation over the lower ribs on the left side, which terminated in the formation of matter beneath the fascia. About a pint was removed on making the necessary opening; and a considerable quantity discharged daily for two or three weeks. On his recovery from this, no change appeared to have taken place in his original complaint; and the opportunity of learning its future progress was lost by his removal to a distant part of the country.

Case V.

In another case, the particulars of which could not be obtained, and the gentleman, the lamented subject of which was only seen at a distance, one of the characteristic symptoms of this malady, the inability for motion, except in a running pace, appeared to exist in an extraordinary degree. It seemed to be necessary that the gentleman should be supported by his attendant, standing before him with a hand placed on each shoulder, until, by gently swaying backward and forward, he had placed himself in equipoise; when, giving the word, he would start, in a running pace, the attendant sliding from before him and running forward, being ready to receive him and prevent his falling, after his having run about twenty paces.

Case VI.

In a case which presented itself to observation since those above-mentioned, every information as to the progress of the malady was very readily obtained. The gentleman who was the subject of it is seventy-two years of age. He has led a life of temperance, and has never been exposed to any particular situation or circumstance which he can conceive likely to have occasioned, or disposed to this complaint; which he rather seems to regard as incidental upon his advanced age, than as an object of medical attention. He however recollects, that about twenty years ago, he was troubled with lumbago, which was severe and lasted some time. About eleven or twelve, or perhaps more, years ago, he first perceived weakness in the left hand and arm, and soon after found the trembling commence. In about three years afterwards the right arm became affected in a similar manner: and soon afterwards the convulsive motions affected the whole body, and began to interrupt the speech. In about three years from that time the legs became affected. Of late years the action of the bowels had been very much retarded; and at two or three different periods had, with great difficulty, been made to yield to the action of very strong cathartics. But within the last twelvemonths this difficulty has not been so great; perhaps owing to an increased secretion of mucus, which envelopes the passing fæces, and which precedes and follows their discharge in considerable quantity.

About a year since, on waking in the night, he found that he had nearly lost the use of the right side, and that the face was much drawn to the left side. His medical attendant saw him the following day, when he found him languid, with a small and quick pulse, and without pain in the head or disposition to sleep. Nothing more therefore was done than to promote the action of the bowels, and apply a blister to the back of the neck, and in about a fortnight the limbs had entirely recovered from their palsied state. During the time of their having remained in this state, neither the arm nor the leg of the paralytic side was in the least affected with the tremulous agitation; but as their paralysed state was removed, the shaking returned.

At present he is almost constantly troubled with the agitation, which he describes as generally commencing in a slight degree, and gradually increasing, until it arises to such a height as to shake the room; when, by a sudden and somewhat violent change of posture, he is almost always able to stop it. But very soon afterwards it will commence in some other limb, in a small degree, and gradually increase in violence; but he does not remember the thus checking of it, to have been followed by an injurious effect. When the agitation had not been thus interrupted, he stated, that it gradually extended through all the limbs, and at last affected the whole trunk. To illustrate his observation as to the power of suspending the motion by a sudden change of posture, he, being then just come in from a walk, with every limb shaking, threw himself rather violently into a chair, and said, "Now I am as well as ever I was in my life." The shaking completely stopped; but returned within two minutes' time.

He now possessed but little power in giving a required direction to the motions of any part. He was scarcely able to feed himself. He had written hardly intelligibly for the last three years; and at present could not write at all. His attendants observed, that of late the trembling would sometimes begin in his sleep, and increase until it awakened him: when he always was in a state of agitation and alarm.

On being asked if he walked under much apprehension of falling forwards? he said he suffered much from it; and replied in the affirmative to the question, whether he experienced any difficulty in restraining himself from getting into a running pace? It being asked, if whilst walking he felt much apprehension from the difficulty of raising his feet, if he saw a rising pebble in his path? he avowed, in a strong manner, his alarm on such occasions; and it was observed by his wife, that she believed, that in walking across the room, he would consider as a difficulty the having to step over a pin.

The preceding cases appear to belong to the same species: differing from each other, perhaps, only in the length of time which the disease had existed, and the stage at which it had arrived.

CHAP. II.

PATHOGNOMONIC SYMPTOMS EXAMINED—TREMOR COACTUS—SCELOTYRBE FESTINANS

It has been seen in the preceding history of the disease, and in the accompanying cases, that certain affections, the tremulous agitations, and the almost invincible propensity to run, when wishing only to walk, each of which has been considered by nosologists as distinct diseases, appear to be pathognomonic symptoms of this malady. To determine in which of these points of view these affections ought to be regarded, an examination into their nature, and an inquiry into the opinions of preceding writers respecting them, seem necessary to be attempted.

1. *Involuntary tremulous motion, with lessened voluntary muscular power, in parts, not in action, and even supported.*

It is necessary that the peculiar nature of this tremulous motion should be ascertained, as well for the sake of giving to it its proper designation, as for assisting in forming probable conjectures, as to the nature of the malady, which it helps to characterise. Tremors were

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[*] Junckeri conspect. de tremore.

[†] Sect. v. Ubi auten solito pauciores deferunter ad eadem organa spiritus animales, imperfectæ ac imbecillæ observantur fieri eadem functiones, in motu tremulo et infirmo, nec diu durante, in visu debili, ac mox defatigato, &c.

Sect. XIX. Inæqualiter, inordinatè, ac præter contraque volutatem moventur spiritus animales per nervos ad partes mobiles, in motu convulsivo, ac tremore, quassuve membtorum coacto.

Distinguendus namque his tremor quiescente licet ac decumbente corpore molustus a motu tremulo, de quo dictum. Sect. v. Quique quiescente corpore cessat, eodemque iterum moto repetit.

Sect. XXV. Coatus tremor debetur animalibus spiritibus inordinatè ac continuo, cum aliquo impetu ad trementium membrorum musculos per nervos propulsis: sive fuerit is universalis, sive particularis, sive corpus fuerit ad huc robustum sive debile, Sylvii de la Boë. Prax. lib. i. cap. xlii.

distinguished by Juncker into Active, those proceeding from sudden affection of the minds, as terror, anger, &c. and Passive, dependant on debilitating causes, such as advanced age, palsy, &c*. But a much more satisfactory and useful distinction is made by Sylvius de la Boë into those tremors which are produced by attempts at voluntary motion, and those which occur whilst the body is at rest†. Sauvages distinguishes the latter of these species (*Tremor Coactus*) by observing, that the tremulous parts leap, and as it were vibrate, even when supported: whilst every other tremor, he observes, ceases, when the voluntary exertion for moving the limb stops, or the part is supported, but returns when we will the limb to move; whence, he says, tremor is distinguished from every other kind of spasm*.

A small degree of attention will be sufficient to perceive, that Sauvages, by this just distinction, actually separates this kind of tremulous motion, and which is the kind peculiar to this disease, from the Genus Tremor. In doing this he is fully warranted by the observations of Galen on the same subject, as noticed by Van Swieten†. "Binas has tremoris species ‡ Galenus subtiliter distinxit, atque etiam diversis nominibus insignivit, tremor enim (τρόμος) facultatis corpus moventis et vehentis infirmitate oboritur. Quippe nemo, qui artus movere non instituerit tremet. Palpitantes autem partes, etiam in quiete fuerint, etiamsi nullum illis motum induxeris palpitant. Ideo primam (*posteriorem*) modo descriptam tremoris speciem, quando quiescenti homini involuntariis illis et alternis motibus agitantur membra, palpitationem (πάλμον) dixit, posteriorem (*primam*) vero, quæ non fit nisi homo conetur partes quasdam movere tremorem vocavit."

Under this authority the term palpitation may be employed to mark those morbid motions which chiefly characterise this disease, notwithstanding that this term has been anticipated by Sauvages, as characteristic of another species of tremor*. The separation of palpitation of the limbs (*Palmos* of Galen, *Tremor Coactus* of de la Boë) from tremor, is the more necessary to be insisted on, since the distinction may assist in leading to a knowledge of the seat of the disease. It is also necessary to bear in mind, that this affection is distinguishable from tremor, by the agitation, in the former, occurring whilst the affected part is supported and unemployed, and being even checked by the adoption of voluntary motion; whilst in the latter, the tremor is induced immediately on bringing the parts into action. Thus an artist, afflicted with the malady here treated of, whilst his hand and arm is palpitating strongly, will seize his pencil, and the motions will be suspended, allowing him to use it for a short period; but in tremor, if the hand be quite free from the affection, should the pen or pencil be taken up, the trembling immediately commences.

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* Nosolog. Methodic. Auctore Fr. Boissier de Sauvages, Tomi. II. Partis ii. p. 54, 1763.

† Comment. in Herman. Boerhaav. Aphorismos. Tom. ii. p. 181.

‡ De tremore. Cap. 3 and 4. Chart, Tom. vii. p. 200 201.

* Sect. XVI. *Tremor palpitans*, Preysinger classis morborum. *Palmos* Galeni. In tremoribus vulgaribus, æqualibus temporum intervallis, non musculus, sed artus ipsemet alternatim attollitur aut deprimitur, aut in oppositas partes it atque redit per minima tamen spatiola; in palpitatione verò sine ullo ordine musculi unius lacertus subito subsilit, nec regulariter continuoque movetur, sed nunc semel aut bis nunc minimè intra idem tempus subsilit; an causa irritans in sensorio communi, an in musculo ipse palpitante Quærenda sit, ignoramus. *Nosologiae Methodicae*, Vol. I. p. 559, 1768.

But the adoption which Sauvages has made of this term, will not be regarded as an absolute prohibition from the employment of it here; since the *tremor palpitans* of Sauvages should be considered rather as a palpitation of the muscles, whilst the motion which is so prominent a symptom in this disease, may be considered as a palpitation of the limbs.

II. *A Propensity to Bend the Trunk Forwards, and to Pass from a Walking to a Running Pace.*—This affection, which observation seems to authorise the being considered as a symptom peculiar to this disease, has been mentioned by few nosologists: it appears to have been first noticed by Gaubius, who says, "Cases occur in which the muscles duly excited into action by the impulse of the will, do then, with an unbidden agility, and with an impetus not to be repressed, accelerate their motion, and run before the unwilling mind. It is a frequent fault of the muscles belonging to speech, nor yet of these alone: I have seen one, who was able to run, but not to walk*."

Sauvages, referring to this symptom, says, another disease which has been very rarely seen by authors, appears to be referable to the same genus (Scelotyrbe, of which he makes *Chorea sancti viti* the first species); which, he says, "I think cannot be more fitly named than hastening or hurrying Scelotyrbe (*Scelotyrbem festinantem, seu festiniam*)."

Scelotyrbe festinans, he says, is a peculiar species of scelotyrbe, in which the patients, whilst wishing to walk in the ordinary mode, are forced to run, which has been seen by Carguet and by the illustrious Gaubius; a similar affection of the speech, when the tongue thus outruns the mind, is termed volubility. Mons. de Sauvages attributes this complaint to a want of flexibility in the muscular fibres. Hence, he supposes, that the patients make shorter steps, and strive with a more than common exertion or impetus to overcome the resistance; walking with a quick and hastened step, as if hurried along against their will. *Chorea Viti,* he says, attacks the youth of both sexes, but this disease only those advanced in years; and adds, that it has hitherto happened to him to have seen only two of these cases; and that he has nothing to offer respecting them, either in theory or practice*.

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* Est et ubi musculi, recte quiden ad voluntatis nutum in actum concitati, injussa dein agilitate atque impetu non reprimendo motus suos accelerant, mentemque invitam præcurrunt. Vitium loquelæ suculis frequens, nec his solis tamen proprium? vidi enim, qui currere, non gradi, piterat*.

* Institution. Patholog. Medicinal. Auctore. H. D. Gaubio. 751.

Having made the necessary inquiries respecting these two affections, *Tremor coactum* of Sylvius de la Boë and of Sauvages, and *Scelotyrbe festinans* of the latter nosologist, which appear to be characteristic symptoms of this disease, it becomes necessary, in the next place, to endeavour to distinguish this disease from others which may bear a resemblance to it in some particular respects.

CHAP. III.

SHAKING PALSY DISTINGUISHED FROM OTHER DISEASES WITH WHICH IT MAY BE CONFOUNDED

Treating of a disease resulting from an assemblage of symptoms, some of which do not appear to have yet engaged the general notice of the profession, particular care is required whilst endeavouring to mark its diagnostic characters. It is sufficient, in general, to point out the characteristic differences which are observable between diseases in some respects resembling each other. But in this case more is required: it is necessary to show that it is a disease which does not accord with any which are marked in the systematic arrangements of nosologists; and that the name by which it is here distinguished has been hitherto vaguely applied to diseases very different from each other, as well as from that to which it is now appropriated.

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* Ad idem genus morbi altera species rarissima ab auctoribus prætervisa referenda videtur, quam non aptius nominari posse putem quàm scelotyrbem festinantem, seu festiniam.

Sect. ii. *Scelotyrbe festinans;* est peculiaris scelotyrbes species in qua ægri solito more dum gradi volunt currere coguntur, quod videre est apud D. Carquet, et observavit Leydæ illustr. Gaubius. *Patholog. instit.* 751, et in loquela hæc *volubilitas* dicitur quâ lingua præcurrit mentem. Video actu mulierem sexagenariam hoc affectam morbo siccitati nervorum tribuendo; laborat enim rheumatismo sicco, seu ab acrimonia sanguinis, dolores nocte a calore recrudescant, à thermis non sublevantur: ei præscripsi phlebotomiam, et præmissis jusculis ex lactucâ, et collo arietis, lene catharticum, inde vero lacticinia.

Est affinitas cum scelotyrbe, chorea viti, deest flexibilitas in fibris musculorum; unde motus breves edunt, et conatu seu impetu solito majori, cum resistentiam illam superare nituntur, velut inviti festinant, ac præcipiti seu concitato passu gradiutur. Chorea viti pueros, puellasve impuberes aggreditur; festinia vero senes, et duos tantum hactenus observare mihi contigit. Quam multos autem videmus morbos, paucissimosque observamus. De theoriâ et pràxi nihil habeo quod dicam; etenim sola experienta praxim cujusvis morbi determinat, et ex hac pro felici vel infausto successu theoria dein elicienda est. *Nosolog. Methodic.* Auctore, Fr. Boissier de Sauvages. Tomi. II. Part ii. p. 108.

Palsy, either consequent to compression of the brain, or dependent on partial exhaustion of the energy of that organ, may, when the palsied limbs become affected with tremulous motions, be confounded with this disease. In those cases the abolition or diminution of voluntary muscular action takes place suddenly, the sense of feeling being sometimes also impaired. But in this disease, the diminution of the influence of the will on the muscles comes on with extreme slowness, is always accompanied, and even preceded, by agitations of the affected parts, and never by a lessened sense of feeling. The dictates of the will are even, in the last stages of the disease, conveyed to the muscles; and the muscles act on this impulse, but their actions are perverted.

Anomalous cases of convulsive affections have been designated by the term Shaking Palsy: a term which appears to be improperly applied to these cases, independent of the want of accordance between them and that disease which has been here denominated Shaking Palsy. Dr. Kirkland, in his commentary on Apoplectic and Paralytic Affections, &c. cites the following case, related by Dr. Charlton, as belonging, he says, to the class of Shaking Palsies. "Mary Ford, of a sanguineous and robust constitution, had an involuntary motion of her right arm, occasioned by a fright, which first brought on convulsion fits, and most excruciating pain in the stomach, which vanished on a sudden, and her right arm was instantaneously flung into an involuntary and perpetual motion, like the swing of a pendulum, raising the hand, at every vibration higher than her head; but if by any means whatever it was stopped; the pain in her stomach came on again, and convulsion fits were the certain consequence, which went off when the vibration of her hand returned."

Another case, which the Doctor designates as "A Shaking Palsy," apparently from worms, he describes thus, "A poor boy, about twelve or thirteen years of age, was seized with a Shaking Palsy. His legs became useless, and together with his head and hands, were in continual agitation; after many weeks trial of various remedies, my assistance was desired.

"His bowels being cleared, I ordered him a grain of Opium a day in the gum pill; and in three or four days the shaking had nearly left him." By pursuing this plan, the medicine proving a vermifuge, he could soon walk, and was restored to perfect health.

Whether these cases should be classed under Shaking Palsy or not, is necessary to be here determined; since, if they are properly ranked, the cases which have been described in the preceding pages, differ so much from them as certainly to oppose their being classed together: and the disease, which is the subject of these pages, cannot be considered as the same with Shaking Palsy, as characterised by those cases.

The term Shaking Palsy is evidently inapplicable to the first of these cases, which appears to have belonged more properly to the genus *Convulsio,* of Cullen, or to *Hieranosos* of Linnæus and Vogel*.

The latter appears to be referable to that class of proteal forms of disease, generated by a disordered state of primæ viæ, sympathetically affecting the nervous influence in a distant part of the body.

Unless attention is paid to one circumstance, this disease will be confounded with those species of passive tremblings to which the term Shaking Palsies has frequently been applied. These are, *tremor temulentus,* the trembling consequent to indulgence in the drinking of spirituous liquors; that which proceeds from the immoderate employment of tea and coffee; that which appears to be dependent on advanced age; and all those tremblings which proceed from the various circumstances which induce a diminution of power in the nervous system. But by attending to that circumstance alone, which has been already noted as characteristic of mere tremor, the distinction will readily be made. If the trembling limb be supported, and none of its muscles be called into action, the trembling will cease. In the real Shaking Palsy the reverse of this takes place, the agitation continues in full force whilst the limb is at rest and unemployed; and even is sometimes diminished by calling the muscles into employment.

CHAP. IV

PROXIMATE CAUSE—REMOTE CAUSES—ILLUSTRATIVE CASES.

Before making the attempt to point out the nature and cause of this disease, it is necessary to plead, that it is made under very unfavorable circumstances. Unaided by previous inquiries immediately directed to this disease, and not having had the advantage, in a single case, of that light which anatomical examination yields, opinions and not facts can only be offered. Conjecture founded on analogy, and an attentive consideration of the peculiar symptoms of the disease, have been the only guides that could be obtained for this research, the result of which is, as it ought to be, offered with hesitation.

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* Corporis agitatio continua, indolens, convulsiva, cum sensibilitate.—*Linn.*

Agitatio corporis vel artuum convulsiva continua, chronica, cum integritate sensuum.—*Vogel.*

This genus is resolved by Cullen into that of Convulsio. *Synops. Nosol.* 1803.

Dr. Macbride has given a very interesting and illustrative case of this disease.

"Hieranasós, or Morbus Sacer, so called, as being vulgarly supposed to arise from witchcraft, or some extraordinary celestial influence, is a distinct genus of disease, though a very uncommon one; the author once had an opportunity of seeing a case. The patient was a lad about seventeen, who at that time had laboured under this extraordinary disease for more than twelve years. His body was so distorted, and the legs and arms so twisted round it, by the continued convulsive working, that no words can give an adequate idea of the oddity of his figure; the agitation of the muscles was perpetual; but in general he did not complain of pain nor sickness; and had his senses perfectly; insomuch that he used to assist his mother, who kept a little school, in teaching children to read." *A methodical Introduction to the Theory and Practice of Physic. By David Macbride, M. D. p.* 559.

SUPPOSED PROXIMATE CAUSE.

A diseased state of the *medulla spinalis,* in that part which is contained in the canal, formed by the superior cervical vertebræ, and extending, as the disease proceeds, to the *medulla oblongata.*

By the nature of the symptoms we are taught, that the disease depends on some irregularity in the direction of the nervous influence; by the wide range of parts which are affected, that the injury is rather in the source of this influence than merely in the nerves of the parts; by the situation of the parts whose actions are impaired, and the order in which they become affected, that the proximate cause of the disease is in the superior part of the medulla spinalis; and by the absence of any injury to the senses and to the intellect, that the morbid state does not extend to the encephalon.

Uncertainty existing as to the nature of the proximate cause of this disease, its remote causes must necessarily be referred to with indecision. Assuming however the state just mentioned as the proximate cause, it may be concluded that this may be the result of injuries of the medulla itself, or of the theca helping to form the canal in which it is inclosed.

The great degree of mobility in that portion of the spine which is formed by the superior cervical vertebræ, must render it, and the contained parts, liable to injury from sudden distortions. Hence therefore may proceed inflammation of quicker or of slower progress, disease of the vertebræ, derangement of structure in the medulla, or in its membranes, thickening or even ulceration of the theca, effusion of fluids, &c.

But in no case which has been noticed, has the patient recollected receiving any injury of this kind, or any fixed pain in early life in these parts, which might have led to the opinion that the foundation for this malady had been thus laid. On the subject indeed of remote causes, no satisfactory accounts has yet been obtained from any of the sufferers. Whilst one has attributed this affliction to indulgence in spirituous liquors, and another to long lying on the damp ground; the others have been unable to suggest any circumstance whatever, which, in their opinion, could be considered as having given origin, or disposed, to the calamity under which they suffered.

Cases illustrative of the nature and cause of this malady are very rare. In the following case symptoms very similar are observable, so far as affecting the lower extremities. That the medulla spinalis was here affected, and in its lower part, is not to be doubted: but this, unfortunately, was never ascertained by examination. It must be however remarked, that this case differed from those which have been given of this disease, in the suddenness with which the symptoms appeared.

A. B. aged twenty-six years, during a course of mercury for a venereal affection, was exposed to severely inclement weather, for several hours, and the next morning, complained of extreme pain in the back, and of total inability to employ voluntarily the muscles of the lower extremities, which were continually agitated with severe convulsive motions. The physician who attended him employed those means which seemed best calculated to relieve him; but with no beneficial effect. The lower extremities were perpetually agitated with strong palpitatory motions, and, frequently, three or four times in a minute, suddenly raised with great vehemence two or three feet from the ground, either in a forward or oblique direction, striking one limb against the other, or against the chairs, tables, or any substance which stood in the way. To check these inordinate motions, no means were in the least effectual, except striking the thighs forcibly during the more violent convulsions. No advantage was derived from all the means which were employed during upwards of twelvemonths. Full ten years after this period, the unhappy subject of this malady was casually met in the street, shifting himself along, seated in a chair; the convulsive motions having ceased, and the limbs having become totally inert, and insensible to any impulse of the will.

It must be acknowledged, that in the well-known cases, described by Mr. Potts, of that kind of Palsy of the lower limbs which is frequently found to accompany a curvature of the spine, and in which a carious state of the vertebræ is found to exist, no instructive analogy is discoverable; slight convulsive motions may indeed happen in the disease proceeding from curvature of the spine; but palpitating motions of the limbs, such as belong to the disease here described, do not appear to have been hitherto noticed.

Whilst striving to determine the nature and origin of this disease, it becomes necessary to give the following particulars of an interesting case of Palsy occasioned by a fall, attended with uncommon symptoms, related by Dr. Maty, in the third volume of the Medical Observations and Inquiries. The subject of this case, the Count de Lordat, had the misfortune to be overturned from a pretty high and steep bank. His head pitched against the top of the coach, and was bent from left to right; his left shoulder, arm, and especially his hand, were considerably bruised. At first he felt a good deal of pain along the left side of his neck, but neither then, nor at any other time, had he any faintings, vomitings, or giddiness.—On the sixth day he was let blood, on account of the pain in his shoulder and the contusion of his hand, which were then the only symptoms he complained of, and of which he soon found himself relieved.—Towards the beginning of the following winter, he began to find *a small impediment in uttering some words, and his left arm appeared weaker.* In the following spring, having suffered considerably from the severities of the winter campaign, he found *the difficulty in speaking, and in moving his left arm, considerably increased.* —On employing the thermal waters of Bourbonne, his speech become freer, but, on his return to Paris, the Palsy was increased, and the arm somewhat wasted.—In the beginning of the next spring he went to Balaruc; when he became affected with *involuntary convulsive motions all over the body.* The left arm withered more and more, *a spitting began,* and now it was *with difficulty that he uttered a few words.* Frictions and sinapisms were successively tried, and an issue, made by a caustic, was kept open for some time without any effect; but no mention is made of what part the issue was established in.

Soon after this, and three years and a half after the fall, Doctor Maty first saw the patient, and gives the following description of his situation. "A more melancholy object I never beheld. The patient, naturally a handsome, middle-sized sanguine man, of a cheerful disposition, and an active mind, appeared much emaciated, stooping, and dejected. He *still walked alone with a cane, from one room to the other, but with great difficulty, and in a tottering manner;* his left hand and arm were much reduced, and would hardly perform any motion; *the right was somewhat benumbed, and he could scarcely lift it up to his head; his saliva was continually trickling out of his mouth, and he had neither the power of retaining it, nor of spitting it out freely.* What words he still could utter were monosyllables, and these came out, after much struggle, in a violent expiration, and with such a low voice and indistinct articulation, as hardly to be understood but by those who were constantly with him. He fetched his breath rather hard; his pulse was low, but neither accelerated nor intermitting. He took very little nourishment, could chew and swallow no solids, and even found great pain in getting down liquids. Milk was almost his only food; his body was rather loose, his urine natural, his sleep good, his senses, and the powers of his mind, unimpaired; he was attentive to, and sensible of every thing which was said in conversation, and shewed himself very desirous of joining in it; but was continually checked by the impediment in his speech, and the difficulty which his hearers were put to. Happily for him he was able to read, and as capable as ever of writing, as he shewed me, by putting into my hands an account of his present situation, drawn up by himself: and I am informed that he spent his time to the very last, in writing upon some of the most abstruse subjects."

This gentleman died about four years after the accident, when the body was examined by Dr. Bellett and Mons. Sorbier, who made the following report:

"We first examined the muscles of the tongue, which were found extenuated and of a loose texture. We observed no signs of compression in the lingual and brachial nerves, as high as their exit from the basis of the cranium and the vertebræ of the neck; but they appeared to us more compact than they commonly are, being nearly tendinous. The dura mater was in a sound state, but the pia mater was full of blood and lymph; on it several hydatids, and towards the falx some marks of suppuration were observed. The ventricles were filled with water, and the plexus choroides was considerably enlarged, and stuffed with grumous blood. The cortical surface of the brain appeared much browner than usual, but neither the medullary part nor cerebellum were impaired. We chiefly took notice of the Medulla Oblongata, this was greatly enlarged, surpassing the usual size by more than one third. It was likewise more compact. The membranes, which, in their continuation, inclose the spinal marrow, were so tough that we found great difficulty in cutting through them, and we observed this to be the cause of the tendinous texture of the cervical nerves. The marrow itself had acquired such solidity as to elude the pressure of our fingers, it resisted as a callous body, and could not be bruised. This hardness was observed all along the vertebræ of the neck, but lessened by degrees, and was not near so considerable in the vertebræ of the thorax. Though the patient was but nine and thirty years old, the cartilages of the sternum were ossified, and required as much labour to cut them asunder as the ribs; like these they were spungy, but somewhat whiter. The lungs and heart were sound. At the bottom of the stomach appeared an inflammation, which increased as it extended to the intestines. The ileum looked of that dark and livid hue, which is observed in membranous parts tending to mortification. The colon was not above an inch in diameter, the rectum was smaller still, but both appeared sound.—From these appearances, we were at no loss to fix the cause of this gradual palsy in the alteration of the medulla spinalis and oblongata."

Dr. Bellett offers the following explanation of these changes. "I conceive, that, by this accident, the head being violently bent to the right, the nervous membranes on the left were excessively stretched and irritated; that this cause extended by degrees to the spinal marrow, which being thereby compressed, brought on the paralytic symptoms, not only of the left arm, but at last in some measure also of the right. This induration seems to have been occasioned by the constant afflux of the nutritive juices, which were stopt at that place, and deprived of their most liquid parts; the grosser ones being unable to spread in the boney cavity, by which they were confined, could only acquire a greater solidity, and change a soft body into a hard and nearly osseous mass. This likewise accounts for the increase of the medulla oblongata, which being loaded with more juices than it could send off, swelled in the same manner as the branches of trees, which will grow of a monstrous size, when the sap that runs into them is stopt in its progress. The medulla oblongata not growing so hard as the spinalis, was doubtless owing to its not being confined in an osseous theca, but surrounded with soft parts, which allowed it room to spread. The obstruction from the bulk of this substance must have affected the brain, and probably induced the thickening of the pia mater, the hydatids, and the beginning of suppuration, whereas the dura mater, being of a harder texture, was not injured*."

In some of the symptoms which appeared in this case, an agreement is observable between it and those cases which are mentioned in the beginning of these pages. The weakened state of both arms; the power first lessening in one arm, and then in a similar manner in the other arm; the affection of the speech; the difficulty in chewing and in swallowing; as well as of retaining, or freely discharging, the spittle; the convulsive motions of the body; and the unimpaired state of the intellects; constitute such a degree of accordance as, although it may not mark an identity of disease, serves at least to show that nearly the same parts were the seat of the disease in both instances. Thus we attain something like confirmation of the supposed proximate cause, and of one of the assumed occasional causes.

Whilst conjecturing as to the cause of this disease, the following collected observations on the effects of injury to the medulla spinalis, by Sir Everard Home, become particularly deserving of attention. It thence appears, that none of the characteristic symptoms of this malady are produced by compression, laceration, or complete division of the medulla spinalis.

"Pressure upon the medulla spinalis of the neck, by coagulated blood, produced paralytic affections of the arms and legs; all the functions of the internal organs were carried on for thirty-five days, but the urine and stools passed involuntarily *.

"Blood extravasated in the central part of the medulla, in the neck, was attended with paralytic affection of the legs, but not of the arms †.

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* Medical Observations and Inquiries, Vol. III. p. 257.

* A coagulum of blood, the thickness of a crownpiece, was found lying upon the external surface of the dura-matral covering of the medulla spinalis, extending from the fourth vertebra colli to the second vertebra dorsi. The medulla spinalis itself was uninjured.

† The sixth and seventh vertebra colli were dislocated, the medulla spinalis, externally, was uninjured; but in the centre of its substance, just at that part, there was a coagulum of blood nearly two inches in length.

"In a case where the substance of the medulla was lacerated in the neck, there was a paralysis in all the parts below the laceration, the lining of the œsophagus was so sensible, that solids could not be swallowed, on account of the pain they occasioned *.

"When the medulla of the back was completely divided, there was momentary loss of sight, loss of memory for fifteen minutes, and permanent insensibility in all the lower parts of the body. The skin above the division of the spinal marrow perspired, that below did not. The wounded spinal marrow appeared to be extremely sensible †". *Philosophical Transactions,* 1816, p. 485.

In two of the cases already noticed, symptoms of rheumatism had previously existed; and in Case IV. the right arm, in which the palpitation began, was said to have been very violently affected with rheumatic pain to the fingers ends. The consideration of this case, in which the palpitation had been preceded, at a considerable distance of time, by this painful affection of the arm, led to the supposition that this latter circumstance might be the cause of the palpitations, and the other subsequent symptoms of this disease. This supposition naturally occasioned the attention to be eagerly fixed on the following case; and of course influenced the mode of treatment which was adopted.

A. B. subject to rheumatic affection of the deltoid muscle, had felt the usual inconveniences from it for two or three days; but at night found the pain had extended down the arm, along the inside of the fore-arm, and on the sides of the fingers, in which a continual tingling was felt. The pain, without being extremely intense, was such as effectually to prevent sleep: and seemed to follow the course of the brachial nerve. Whilst ascertaining the propriety of this conclusion, the pain was found to ramify, as it were, on the fore and back part of the chest; and was slightly augmented by drawing a deep breath.

These circumstances suggested the probability of slight inflammation, or increased determination to the origin of the nerves of these parts, and to the neighbouring medulla. On this ground, blood was taken from the back part of the neck, by cupping; hot fomentations were applied for about the space of an hour, when the upper part of the back of the neck was covered with a blister, perspiration was freely induced by two or three small doses of antimonials, and the following morning the bowels were evacuated by an appropriate dose of calomel. On the following day the pains were much diminished, and in the course of four or five days were quite removed. The arm and hand felt now more than ordinarily heavy, and were evidently much weakened: aching, and feeling extremely wearied after the least exertion. The strength of the arm was not completely recovered at the end of more than twelvemonths; and, after more than twice that time, exertion would excite the feeling of painful weariness, but no palpitation or other unpleasant symptom has occurred during the five or six years which have since passed.

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* The seventh vertebra colli was fractured, and the medulla spinalis passing through it, was lacerated and compressed.

† The spinal marrow, within the canal of the sixth vertebra dorsi, was completely destroyed by a musket ball. The person lived four days.

The commencement, progress, and termination of this attack; with the success attending the mode of treatment, and the symptoms which followed, seem to lead to the conjecture, that the proximate cause of the disease, in this case, existed in the medulla spinalis, and that it might, if neglected, have gradually resolved itself into that disease which is the object of our present inquiry.

Some few months after the occurrence of the preceding case, the writer of these lines was called to a female about forty years of age, complaining of great pain in both the arms, extending from the shoulder to the finger ends. She stated, that she was attacked in the same manner as is described in the preceding case, about nine months before; that the complaint was considered as rheumatism, and was not benefited by any of the medicines which had been employed; but that after three or four weeks it gradually amended, leaving both the arms and hands in a very weakened and trembling state. From this state they were now somewhat recovered; but she was extremely anxious, fearing that if the present attack should not be soon checked, she might entirely lose the use of her hands and arms.

Instructed by the preceding case, similar means were here recommended. Leeches, stimulating fomentations, and a blister, which was made for sometime to yield a purulent discharge, were applied over the cervical vertebræ; and in the course of a very few days the pain was entirely removed. It is regretted that no farther information, as to the progress of this case, could be obtained.

On meeting with these two cases, it was thought that it might not be improbable that attacks of this kind, considered at the time merely as rheumatic affections, might lay the foundation of this lamentable disease, which might manifest itself at some distant period, when the circumstance in which it had originated, had, perhaps, almost escaped the memory. Indeed when it is considered that neither in the ordinary cases of Palsy of the lower extremities, proceeding from diseased spine, nor in cases of injured medulla from fractured vertebræ, any of the peculiar symptoms of this disease are observable, we necessarily doubt as to the probability of its being the direct effect of any sudden injury. But taking all circumstances into due consideration, particularly the very gradual manner in which the disease commences, and proceeds in its attacks; as well as the inability to ascribe its origin to any more obvious cause, we are led to seek for it in some slow morbid change in the structure of the medulla, or its investing membranes, or theca occasioned by simple inflammation, or rheumatic or scrophulous affection.

It must be too obvious that the evidence adduced as to the nature of the proximate and occasional causes of this disease, is by no means conclusive. A reference to the test therefore which will be yielded by an examination of some of the more prominent symptoms, especially as to their agreement with the supposed proximate cause, is more particularly demanded. Satisfied as to the importance of this part of the present undertaking, no apology is offered for the extent to which the examination is carried on.

If the palpitation and the attendant weakness of the limbs, &c. be considered as to the order in which the several parts are attacked, it is believed, that some confirmation will be obtained of the opinion which has been just offered, respecting the cause, or at least the seat, of that change which may be considered as the proximate cause of this disease.

One of the arms, in all the cases which have been here mentioned, has been the part in which these symptoms have been first noticed; the legs, head, and trunk have then become gradually affected, and lastly, the muscles of the mouth and fauces have yielded to the morbid influence.

The arms, the parts first manifesting disorder action, of course direct us, whilst searching for the cause of these changes, to the branchial nerves. But finding the mischief extending to other parts, not supplied with these, but with the other nerves derived from nearly the same part of the medulla spinalis, we are of course led to consider that portion of the medulla spinalis itself, from which these nerves are derived, as the part in which those changes have taken place, which constitute the proximate cause of this disease.

From the subsequent affection of the lower extremities, and from the failure of power in the muscles of the trunk, such a change in the substance of the medulla spinalis may be inferred, as shall have considerably interrupted, and interfered with, the extension of the nervous influence to those parts, whose nerves are derived from any portion of the medulla below the part which has undergone the diseased change.

The difficulty in supporting the trunk erect, as well as the propensity to the adopting of a hurried pace, is also referable to such a diminution of the nervous power in the extensor muscles of the head and trunk, as prevents them from performing the offices of maintaining the head and body in an erect position.

From the impediment to speech, the difficulty in mastication and swallowing, the inability to retain, or freely to eject, the Saliva, may with propriety be inferred an extension of the morbid change upwards through the medulla spinalis to the medulla oblongata, necessarily impairing the powers of the several nerves derived from that portion into which the morbid change may have reached. In the late occurrence of this set of symptoms, and the extension upwards of the diseased state, a very close agreement is observable between this disease and that which has been already shown, proved fatal to the Count de Lordat. But in this case, the disease doubtlessly became differently modified, and its symptoms considerably accelerated, in consequence of the magnitude of the injury by which the disease was induced.

CHAP. V.

CONSIDERATIONS RESPECTING THE MEANS OF CURE.

The inquiries made in the preceding pages yield, it is to be much regretted, but little more than evidence of inference: Nothing direct and satisfactory has been obtained. All that has been ventured to assume here, has been that the disease depends on a disordered state of that part of the medulla which is contained in the cervical vertebræ. But of what nature that morbid change is; and whether originating in the medulla itself, in its membranes, or in the containing theca, is, at present, the subject of doubt and conjecture. But although, at present, uniformed as to the precise nature of the disease, still it ought not to be considered as one against which there exists no countervailing remedy.

On the contrary, there appears to be sufficient reason for hoping that some remedial process may ere long be discovered, by which, at least, the progress of the disease may be stopped. It seldom happens that the agitation extends beyond the arms within the first two years; which period, therefore, if we were disposed to divide the disease into stages, might be said to comprise the first stage. In this period, it is very probable, that remedial means might be employed with success: and even, if unfortunately deferred to a later period, they might then arrest the farther progress of the disease, although the removing of the effects already produced, might be hardly to be expected.

From a review of the changes which had taken place in the case of Count de Lordat, it seems as if we were able to trace the order and mode in which the morbid changes may proceed in this disease. From any occasional cause, the thecal ligament, the membranes, or the medulla itself, may pass into the state of simple excitement or irritation, which may be gradually succeeded by such a local afflux and determination of blood into the minute vessels, as may terminate in actual but slow inflammation. The result of this would be a thickening of the theca, or membranes, and perhaps an increase in the volume of the medulla itself, which would gradually occasion such a degree of pressure against the sides of the unyielding canal, as must eventually intercept the influence of the brain upon the inferior portion of the medullary column, and upon the parts on which the nerves of this portion are disposed.

From this review, and assuming that the morbid changes in this disease may not be widely dissimilar from those which occurred in the case of Count de Lordat, the chance of relief from the proposed mode of treatment may appear to be sufficient to warrant its trial.

In such a case then, at whatever period of the disease it might be proposed to attempt the cure, blood should be first taken from the upper part of the neck, unless contra-indicated by any particular circumstance. After which vesicatories should be applied to the same part, and a purulent discharge obtained by appropriate use of the Sabine Liniment; having recourse to the application of a fresh blister, when from the diminution of the discharging surface, pus is not secreted in a sufficient quantity. Should the blisters be found too inconvenient, or a sufficient quantity of discharge not be obtained thereby, an issue of at least an inch and a half in length might be established on each side of the vertebral columna, in its superior part. These, it is presumed, would be best formed with caustic, and kept open with any proper substance *.

Could it have been imagined that such considerable benefit: indeed, that such astonishing cures, could have been effected by issues in cases of Palsy of the lower extremities from diseased spine? although satisfied with ascribing those cases to scrofulous action, we are in fact as little informed respecting the nature of the affection, inducing the carious state of the vertebræ, as we are respecting the peculiar change of structure which takes place in this disease. Equally uninformed are we also as to the peculiar kind of morbid action, which takes place in the ligaments of the joints; as well as that which takes place in different instances of deep seated pains and affections of the parts contained in the head, thorax, and abdomen, and in all which cases the inducing of a purulent discharge in their neighborhood is so frequently productive of a cure. Experiment has not indeed been yet employed to prove, but analogy certainly warrants the hope, that similar advantages might be derived from the use of the means enumerated, in the present disease. It is obvious, that the chance of obtaining relief will depend in a great measure on the period at which the means are employed. As in every

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* Cork, which has been hitherto neglected, appears to be very appropriate to this purpose. It possesses lightness, softness, elasticity and sufficient firmness; and is also capable of being readily fashioned to any convenient form. The form which it seems would be best adapted to the part, is that of an almond, or of the variety of bean called scarlet bean; but at least an inch and a half in length.

other disease, so here, the earlier the remedies are resorted to, the greater will be the probability of success. But in this disease there is one circumstance which demands particular attention; the long period to which it may be extended. One of its peculiar symptoms Scelotyrbe festinans, may not occur until the disease has existed ten or twelve years, or more; hence, when looking for the period, within which our hopes of remedial aid is to be limited; we may, guided by the slow progress of the malady, extend it to a great length, when compared with that within which we should be obliged to confine ourselves in most other diseases.

But it is much to be apprehended, as in many other cases, that the resolution of the patients will seldom be sufficient to enable them to persevere through the length of time which the proposed process will necessarily require. As slow as is the progress of the disease, so slow in all probability must be the period of the return to health. In most cases, especially in those in which the disease has been allowed to exist long unopposed, it may be found that all that art is capable of accomplishing, is that of checking its further progress. Nor will this be regarded as a trifle, when, by reference to the history of the disease, is seen the train of harassing evils which would be thus avoided.

But it seems as if there existed reason for hoping for more. For supposing change of structure to have taken place, it is extremely probable that this change may be merely increase in mass or volume by interstitial addition, the consequence of increased action in the minute vessels of the part. In that case, should the instituting of a purulent discharge, in a neighbouring part, act in the manner which we would presume it may—should it by keeping up a constant discharge, not merely alter the determination, but diminish the inordinate action of the vessels in the diseased part; and at the same time excite the absorbents to such increased action as may remove the added matter; there will exist strong ground for hope, that a happy, though slow restoration to health, may be obtained.

Until we are better informed respecting the nature of this disease, the employment of internal medicines is scarcely warrantable; unless analogy should point out some remedy the trial of which rational hope might authorize. Particular circumstances indeed must arise in different cases, in which the aid of medicine may be demanded: and the intelligent will never fail to avail themselves of any opportunity of making trial of the influence of mercury, which has in so many instances, manifested its power in correcting derangement of structure.

The weakened powers of the muscles in the affected parts is so prominent a symptom, as to be very liable to mislead the inattentive, who may regard the disease as a mere consequence of constitutional debility. If this notion be pursued, and tonic medicines, and highly nutritious diet be directed, no benefit is likely to be thus obtained; since the disease depends not on general weakness, but merely on the interruption of the flow of the nervous influence to the affected parts.

It is indeed much to be regretted that this malady is generally regarded by the sufferers in this point of view, so discouraging to the employment of remedial means. Seldom occurring before the age of fifty, and frequently yielding but little inconvenience for several months, it is generally considered as the irremediable diminution of the nervous influence, naturally resulting from declining life; and remedies therefore are seldom sought for.

Although unable to trace the connection by which a disordered state of the stomach and bowels may induce a morbid action in a part of the medulla spinalis, yet taught by the instruction of Mr. Abernethy, little hesitation need be employed before we determine on the probability of such occurrence. The power, possessed by sympathy, in inducing such disordered action in a distant part, and the probability of such disordered action producing derangement of structure, can hardly be denied. The following Case seems to prove, at least, that the mysterious sympathetic influence which so closely simulates the forms of other diseases, may induce such symptoms as would seem to menace the formation of a disease not unlike to that which we have been here treating of.

A. B. A man, 54 years of age, of temperate habits and regular state of bowels, became gradually affected with slight numbness and prickling, with a feeling of weakness in both arms, accompanied by a sense of fulness about the shoulders, as if produced by the pressure of a strong ligature; and at times a slight trembling of the hands. During the night, the fulness, numbness, and prickling were much increased. The appetite had been diminished for several weeks; and the abdomen, on being examined, felt as though containing considerable accumulation.

Before adopting any other measures, and as there appeared to be no marks of vascular fulness, it was determined to empty the bowels. This was done effectually by moderate doses of calomel, with the occasional help of Epsom salts; and in about ten days, by these means alone, the complaints were entirely removed.

Before concluding these pages, it may be proper to observe once more, that an important object proposed to be obtained by them is, the leading of the attention of those who humanely employ anatomical examination in detecting the causes and nature of diseases, particularly to this malady. By their benevolent labours its real nature may be ascertained, and appropriate modes of relief, or even of cure, pointed out.

To such researches the healing art is already much indebted for the enlargement of its powers of lessening the evils of suffering humanity. Little is the public aware of the obligations it owes to those who, led by professional ardour, and the dictates of duty, have devoted themselves to these pursuits, under circumstances most unpleasant and forbidding. Every person of consideration and feeling, may judge of the advantages yielded by the philanthropic exertions of a HOWARD; but how few can estimate the benefits bestowed on mankind, by the labours of a MORGAGNI, HUNTER, or BAILLIE.

FINIS.

PARKINSON'S DISEASE

A CLINICAL STUDY OF ONE HUNDRED AND FORTY-SIX CASES *

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AND
DAVID M. LEVY, M.D.
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In this study only those cases were included in which the diagnosis was thought to be certain. Postencephalitic cases were not considered. For estimation of age and sex incidence 146 cases were used; for clinical studies, 140. The advantages of these records for source material as compared with hospital records are their uniformity, since they have all been under the direction of one person and written by a small number of historians (each has averaged about four years), and their brevity which, since only the more significant data are recorded, is in favor of greater accuracy. Their disadvantages are their occasional incompleteness and the limitation to positive data and to private cases. The restriction of statements to positive findings is compensated for by the fact that conclusions drawn from the recorded facts are minimal and therefore conservative. That age and sex distribution among private and dispensary cases runs along the same curve has been shown by Erb.[1] As numerous studies of the same subject have been previously recorded, only points of contrast and of special interest will be noted.

AGE DISTRIBUTION

By decades, the 146 cases fall into the usual sequence. Figure 1 shows the well established order of frequency. Of this group 80 per cent. are between 40 and 70 and 55 per cent. above 50 years of age at the onset of the disease. The age incidence reported by different authors is strikingly uniform. Figure 2 represents percentage distribution for the cases of Souques,[2] Dana,[3] and Patrick. The discrepancies appear only at the ends of the scale where cases are few and slight differences in number make comparatively large percentage differences.

When it is remembered that these curves are for groups of from 100 to 150 cases, each group representing a different part of Europe or America, their similarity is significant. It indicates that paralysis

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* Read before the Chicago Neurological Society. The cases are from the private records of one of us (H. T. P.).

[1] Erb, Wilhelm, in Church: Diseases of the Nervous System, in Modern Clinical Medicine, 1908.

[2] Souques, A.: Rev. neurol. **28**:552, 1921.

[3] Dana, Charles L.: Nervous Diseases, New York, William Wood & Co., 1919.

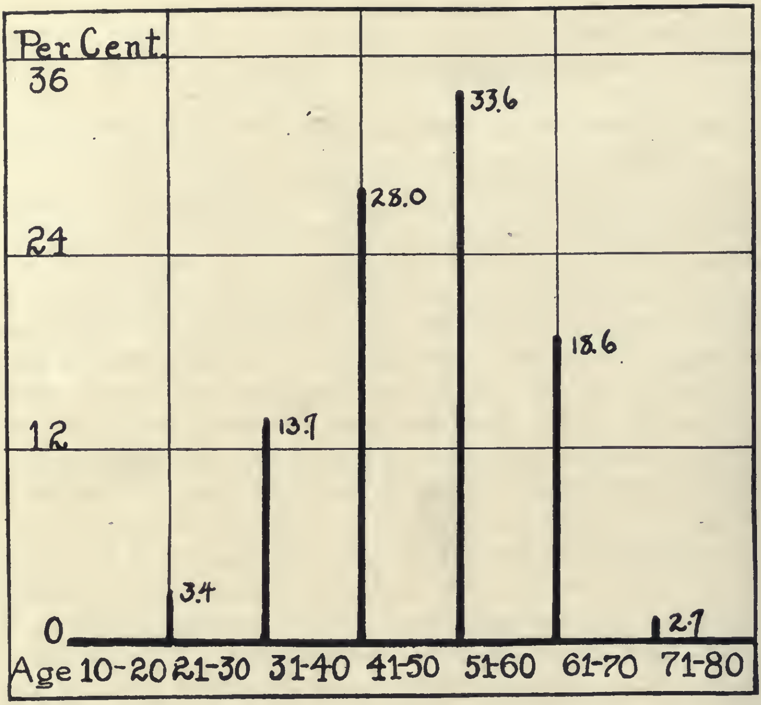

Fig. 1.—Percentage of distribution according to age at the onset of the disease in 146 cases of paralysis agitans.

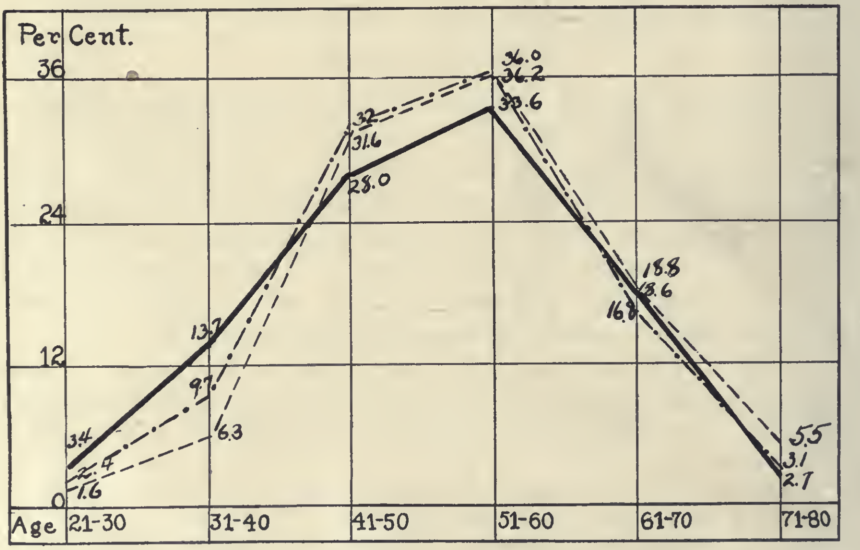

Fig. 2.—Percentage of distribution of paralysis agitans by age in decades. Souques' 125 cases are indicated by the dash and dot line, Dana's 127 cases by the dash line and Patrick's 146 cases by the continuous line.

agitans is a definite entity. Moreover, it adds weight to conclusions derived from the study of any one series, since they probably would hold for the others.

Age distribution in the sexes is practically the same. A small difference may be partly accounted for by the smaller number of cases in our female series (58), hence a greater element of chance (Figs. 3 and 4).

The age incidence of paralysis agitans taken regardless of the general population of each decade has limited value. It is obvious that one case in a group of ten shows relatively a much greater frequency value than five cases in a group of 100; and it follows that one case in a person in the seventies, a decade in which only 2 per cent. of the population are represented, is relatively more than three times as frequent as one case in a person in the fifties, a decade in which 7 per cent. of the population are represented. Taking the number of cases in the fifties as a basis for comparison, the values in Figure 1 have been interpreted in terms of relative frequency values in the table. The percentage distribution of the native population by decades, on the basis of which frequency values are derived, is also shown in this table, which indicates that this disease is relatively more frequent in the sixties than in the forties, more frequent in the seventies than in the thirties, and rare in the twenties. It is relatively two and a half times as frequent in persons over 50 as in persons under 50. This is in favor of the theory that the disease is a degenerative process.

Relative Frequency Values

Age	No. of Cases	Percentage Distribution by Decade, Native Population, 1910.	Frequency Values
20-30	5	17.7	1.8
31-40	20	13.1	10.5
41-50	41	9.2	30.7
51-60	49	6.9	49.0
61-70	27	4.4	42.3
71-80	4	2.1	13.1
	146		147.4

SEX

The ratio of males to females in this series is as 3 to 2. A preponderance of males over females has been found by most workers studying large series. Erb's ratio like that of Gowers[4] was 2 to 1 in

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[4] Gowers: Diseases of the Nervous System, 1893, Vol. 7, p. 637.

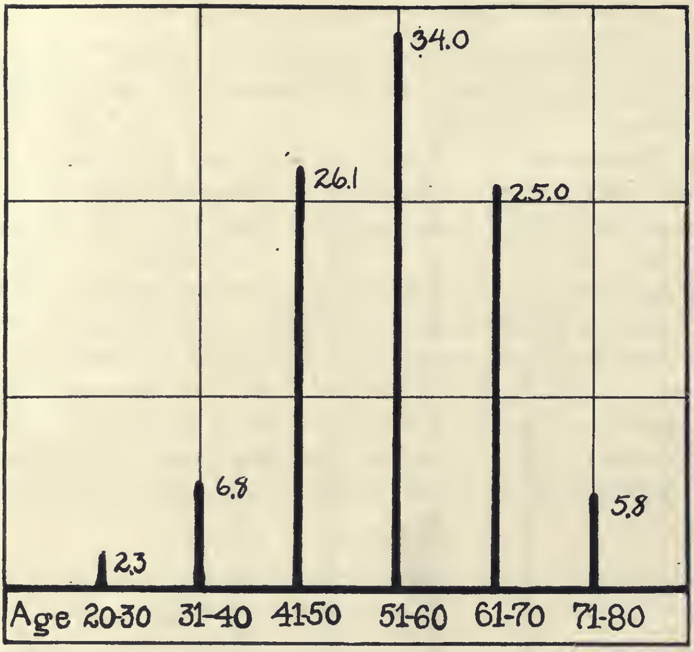

Fig. 3.—Percentages of distribution in males according to age (eighty-eight cases).

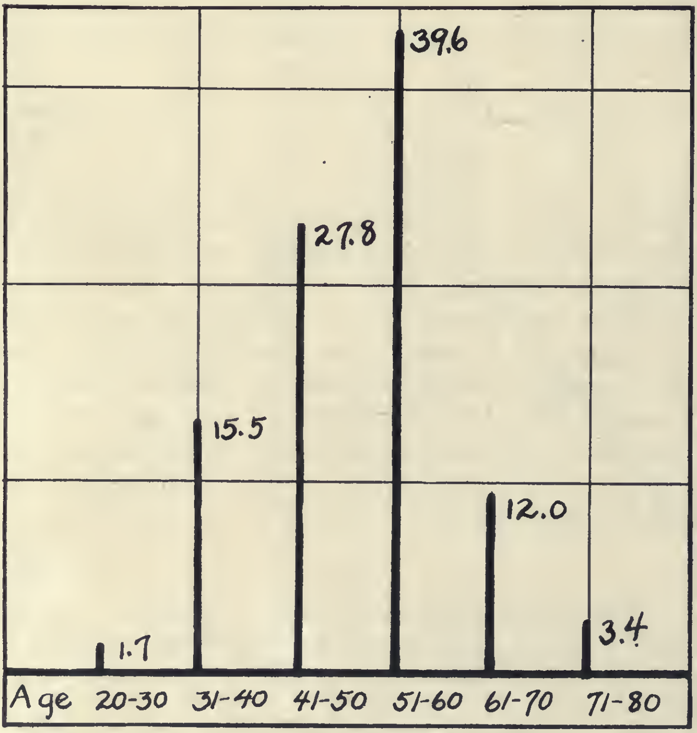

Fig. 4.—Percentage of distribution in females, according to age (fifty-eight cases).

favor of males. Reverse findings are largely confined to smaller series in which chance factors are greater.[5]

TRAUMA

There was a history of trauma in twenty-two cases. In three of these patients the trauma was operative—a left mastoid operation, removal of a cervical rib, and fracture of the jaw during extraction of a molar tooth. Apparently there is a high correlation between the site of trauma and the site of the first symptom of the disease, the tremor or rigidity taking its lead from the traumatized part, regardless of the time interval between the injury and the onset of the disease. For example, a man aged 39 at the onset of the disease, gave a history of a fall from a colt at 12 or 13 years of age, landing on his right shoulder and suffering from pain in that shoulder for a year. The right hand was first involved by the tremor. A man, aged 56 at the onset of the disease, which started in his left arm, had had his left hand cut off thirty-five years before. On the other hand, within two months following a fall in which the left arm was sprained, a man aged 65 at the onset of his disease, had the initial tremor in the left hand. Cases of paralysis agitans following trauma and affecting the injured side within a day have been described. In nine of our cases the trauma was of one designated extremity; in seven this extremity was the first involved; in one the opposite limb showed the first sign of the disease, and in one the other limb on the same side.

That the predilection may be for a part injured by disease is shown by the correlation of the onset with a part affected by rheumatic arthritis or some other nontraumatic disease. Of eight patients in whom a single extremity was thus affected, in six the first symptom of paralysis agitans appeared in the same extremity. Possibly not in agreement was the case of a man aged 48 at the time of the onset, who had had a right hemiplegia during the last ten years, and in whom the disease started on the unaffected side. As in the cases of trauma, there is no relation between the time of disease in an extremity and the time of onset of the initial symptom. In the nonoperative trauma group there were sixteen males and three females. The three operative cases were in females. The close relation between the area traumatized and the distribution of the symptoms has been especially emphasized by Mendel [5] and Oppenheim [6] and is apparently a frequent observation. Of course trauma is not to be considered as a direct etiologic factor,[7] but that it is a predisposing influence to the locus of onset of the disease, if it occurs, is borne out by these findings. Erb would add to the election of the traumatized part the factor of physical strain; he cites a case in which the part first affected in a painter was the left hand in which he held his palette.

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[5] Mendel, K.: Die Paralysis Agitans, Berlin, S. Karger, 1911. See Mendel's review of these and other lists.

[6] Oppenheim, H.: Text-Book of Nervous Diseases, Ed. 5 **2**:1298, 1911.

[7] Pearce, F. S.: Trauma as an Exciting Cause of Paralysis Agitans, Phil. M. J., May 25, 1901, p. 1019.

To prove that trauma is an etiologic factor it would be necessary to show that the chances for getting the disease are greater in the traumatized part of the population. Such statistics are not at hand, nor does it seem likely that there is a less frequent history of trauma in the general population than in our lists (15 per cent.). This is no more significant than the predilection of rheumatic arthritis for a part receiving injury or bearing strain, or the predilection of syphilitic gummas for the frontal bones of Mohammedans, who in bowing to Allah repeatedly scrape their foreheads on cold marble.[8]

MENTAL SYMPTOMS

As described by most authors such symptoms are largely depressive reactions to the hopelessness of the disease. Wilson[9] writes that the mental symptoms are "limited to a depression of mood, the natural outcome perhaps of an incurable disease, and to an irritability also explicable by the nature of the ailment; anything beyond these is to be ascribed either to a concomitant arteriosclerosis or to some incidental condition." As recorded in this series, mental symptoms are naturally grouped as they occur before or after the disease and in the following order:

Group 1. History of acute mental symptoms following "shock" at or before onset of the first symptom of the disease. There are six cases in this group—three in males and three in females. In four of these the symptoms occurred within a year before the onset of paralysis agitans. Symptoms under this heading were: marked grief following death of wife and in this state when paralysis agitans began; frightened by burglar and in bed one month with weakness and "nerves"; breakdown and in a sanatorium for three months; great emotional shock and strain. The ages of the patients at the onset of acute mental symptoms were: 31, 46, 20, 51, 45 and 66; and at the onset of paralysis agitans in the same order: 31, 47, 50, 51, 53 and 66.

Group 2. History of depression preceding onset; seven cases: three in males and four in females. Under this heading such cases as the following were included: (1) Depressed, crying spells, suicidal thoughts, quitting work on account of depression, gradual improvement with return of symptoms two years ago with first symptom of paralysis agitans; (2) periodic depression one to two years preceding; (3)

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[8] Lacapère and Laurent: Paris méd. **8**:94, 1918.

[9] Wilson, S. A. K.: Diseases of the Central Nervous System, Oxford Medicine, Vol. 6, Oxford, 1921.

depression four years preceding, attempted suicide by gas followed two days after the first attempt by the first symptom of paralysis agitans; (4) depression for ten years preceding onset with suicidal feelings.

Group 3. This is a less definite group. The patients were "very nervous," "highstrung," "worrisome," of a "nervous temperament," "easily upset" and "excited at least provocation." This group comprises twenty cases: thirteen in males and seven in females. In this group three patients showed fear—fear of something dreadful, a choking sensation with fear of death, fear of the shaking palsy. Three were patients with some form of apathy—apathetic, loss of interest; loss of ambition preceding the first symptom by six months; crying spells and careless of appearance. Generally these symptoms had preceded the paralysis agitans.

Mental symptoms during the course of the disease are recorded in twenty cases, but five of these are considered in the first group as occurring also before the onset. Of the fifteen remaining patients (seven males, eight females), depression or loss of interest is noted in ten (depressed only since onset of paralysis agitans, cries while examined; crying spells over condition for past nine months; depressed, careless of appearance and frequent crying past two months; nervous, depressed, insomnia, convinced is going to die, etc.). Worries and fears are noted in two cases; mental slowing-up, confusion, memory defects in three. In these three groups there are forty-eight cases, or 34 per cent. Even discounting Group 3 as being ambiguous, there remain twenty-eight, or 20 per cent., of whom definite mental symptoms are recorded. Especially noteworthy is the fact that mental symptoms are recorded more frequently as occurring before the onset of paralysis agitans than after, and as far as these records go, a depressive reaction is as frequent before the onset of the classical signs of the disease as after. There is no record of bonhomie as noted by Oppenheim[6] and only one record of periods of excitement. Actual mental deterioration is not mentioned in these records. The percentages found by other writers are in fair agreement.

Heredity findings are as in other reports: "Neuropathic" heredity in about 25 per cent. and direct heredity in six cases, of which two are questionable. Of these, the mother, the father, and a brother, had paralysis agitans. In the two questionable cases, the father also had a marked tremor, and the father had "the same tremor." Insanity (not described), one; melancholia, one; epilepsy, four; and migraine, three, are noted in antecedents.

Menopause or menstrual disturbance occurred in only ten cases, not a significant number for a group of fifty-eight women—of these, six had mental symptoms.

The complications are similar to the list in Mendel's monograph: tabes, one; hemiplegia, two; trifacial neuralgia, two; hyperthyroidism, one; diabetes, one. Two brothers of the patient with tabes, aged 70 when first seen, had general paresis. One of the cases complicated with hemiplegia was that of a printer, aged 65 at the time of onset, with tremor in the right hand which later involved the left. About fourteen months after the initial tremor he had a right hemiplegia with disappearance of the tremor on the right. With gradual recovery of the use of the right arm the tremor returned. Such a case was first described by Parkinson—one of his six cases.

Besides the unusual cases included under "complications," the following may be mentioned: hemiparalysis agitans, fifteen cases. These were cases usually seen early in the disease in which the tremor at the time of the examination was limited to one side, with however the typical gait, attitude and facies. In three of these cases the duration was one year or less; in eight, from one to two years; in three from two to three years. In one case the disease was of eight years' duration, and with minimal rigidity. In only four of these cases was the rigidity severe.

Unusual in this as contrasted with other series is the number (five) of patients with one-sided facial involvement.[10] In one of these cases the diagnosis was in doubt for a long time.[11] These cases of one-sided facial involvement occurred in the hemiparalysis agitans group and represent a fairly complete unilateral involvement including the face. No reference to such a series could be found in the literature.

Intention tremor was found in eighteen, or about 13 per cent. of all cases, indicating that the typical tremor is not invariable, a point already made with sufficient emphasis in the literature. Absence of tremor (paralysis agitans sine agitatione) is recorded in only five cases, in contrast with Erb's 20 per cent. The latter, however, included also cases with minimal tremor, a group not considered in this list. In these cases the duration was in order: seven months, two years, three years, five years and six years. Cases without rigidity (sine rigiditate) are thought to be the rarest of all types; not one was found in Erb's group of 183 cases. This condition was recorded in two patients in our series, one in a woman aged 46, who for one year and three months had shown the typical attitude of face and body. This was preceded by severe constant pain in the right arm which disappeared when the typical attitude began. The second case was that of a man, aged 51, who had had typical tremor of the left hand and arm for eighteen months with tremor in both legs for six months. Not the slightest rigidity was determined in either case.

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[10] Patrick, Hugh T.: An Unusual Case of Paralysis Agitans, Arch. Neurol. & Psychiat., Proc. Chicago Neurol. Soc., this issue, p. 790.

[11] Patrick, Hugh T.: J. Nerv. & Ment. Dis. **30**:469, 1903.

Three cases are classified in the "bulbar" group. One patient had slight difficulty in swallowing, one had choking spells at night and the third had marked difficulty in swallowing food. In these three cases the disease had made some progress before the "bulbar" symptoms commenced.

The focal distribution is represented in Figure 5. The extremities involved at the time of the last examination with the order of progress are indicated by numbers. For each type the number of cases seen is in the lower right hand corner in Roman numerals.

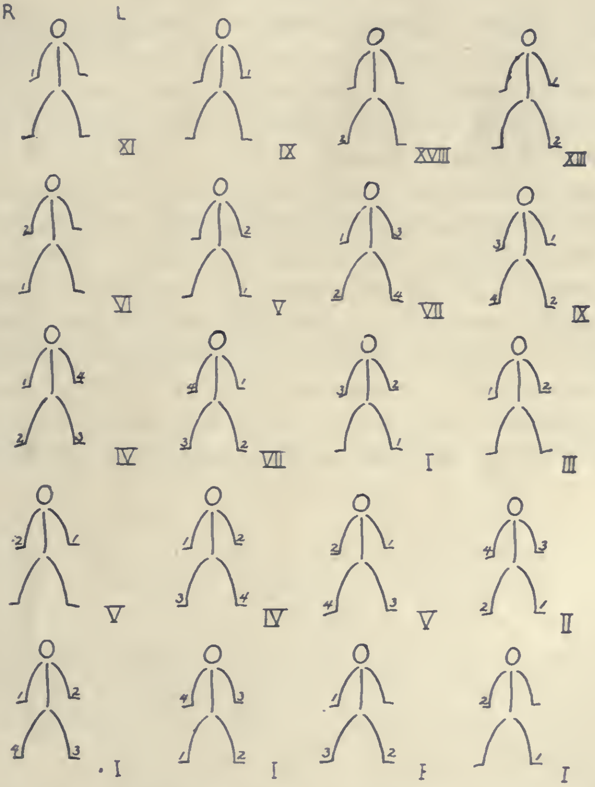

Fig. 5.—Focal distribution showing extremities involved at time of last examination with the order of progress are indicated by numbers. For each type the number of cases seen is in the lower right hand corner in Roman numerals.

SUMMARY

One hundred and forty-six private cases of "classical" paralysis agitans were used for studies in age and sex distribution; 140 for clinical studies. Frequency by decades was found to be greatest in the fifties and next in the forties; 80 per cent. of the patients were between 40 and 70 and 55 per cent. over 50 years of age. These findings agree with other statistics. Considered in relation to the age incidence of the general population, the vast majority of patients are over 50 when the disease begins, and the onset is relatively more frequent in the seventies than in the thirties. The ratio of males to females was 3 to 2. Trauma occurred in twenty-two cases, and in these as in the histories of infected parts it was shown that the symptoms of paralysis agitans tend to start in a traumatized or diseased part. Since in this series there was a history of trauma in only 15 per cent. of all cases, it cannot be concluded that trauma is predisposing in any sense except as to the site of the initial symptom.

A large number of mental symptoms were shown by forty-eight patients, or in 34 per cent. of the cases. In contrast with the findings in other studies, mental symptoms were found to occur as frequently before as after the onset of the disease. These symptoms were largely in the form of depressive reaction.

Menstrual disturbances were found to be of no special significance. Heredity findings were not significant except in the form of "neuropathic heredity" in about 25 per cent. of the cases. Direct heredity of the disease was traced in six cases. The complications were: tabes, one; hemiplegia, two; trifacial neuralgia, two; hyperthyroidism, one, and diabetes, one. Fifteen patients had hemiparalysis agitans; eighteen cases were accompanied by intention tremor; five patients had one-sided facial involvement; four had paralysis agitans sine agitatione, two paralysis agitans sine rigiditate, and three had "bulbar symptoms."

HEREDITY IN EPILEPSY

A STUDY OF ONE THOUSAND FOUR HUNDRED AND FORTY-NINE CASES *

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There are still people who use "congenital" and "inherited" as synonyms, and who speak of inherited (meaning congenital) syphilis, forgetting that the parent is merely the carrier of a foreign body, a spirochete, to the fetus, and that there is nothing genetic in the process. Many accept the appearance of a disease or abnormality in successive generations as absolute proof of heredity: it is not, as is shown in "miner's phthisis," in which the exposure to the same environment is the cause, and not heredity. I shall use J. Arthur Thompson's definition of heredity. He says "by inheritance we mean all the qualities or characters which have their initial seat, their physical basis, in the fertilized egg cell; the expression of this inheritance in development results in the organism. Thus, heredity is no entity, no force, no principle, but a convenient term for the genetic relation between successive generations, and inheritance includes all that the organism is or has to start with in virtue of its hereditary relation."

We must also define "disease" and "a disease." T. Clifford Albutt defines disease most clearly and accurately as "a state of a living organism, a balance of function more unstable than that which we call 'health'; its causes may be imported, or the system may 'rock' from some implicit defect, but the disease itself is a perturbation which contains no elements essentially different from those of health, but elements presented in a different and less useful order." I shall use the phrase "a disease" to mean a perversion or cessation of functions or a function, having one specific cause, running a characteristic clinical course, acute or chronic, and showing either no anatomic changes or changes that are characteristic. Professor Martius gives this definition: "A disease is not an entity, not a character, but a process—an abnormal process injurious to the organism, which is set a-going by a *causa externa* and runs its course in some part of the body." Philosophically speaking, Martius' definition may be the more scientific, but in deciding, as we shall have to do, whether epilepsy is a disease, the one I use is the more useful for clinicians as it explains the elements which are necessary to bring a morbid process into the category of a distinct disease. As I have defined the phrase, epilepsy is not a disease, but, after excluding all cases of epileptiform convulsions with known causes, there is a group left which we, for convenience sake, call idiopathic epilepsy; this paper is concerned only with that group. I have excluded all cases in which there was evidence of gross cerebral disease, such as injuries at birth, meningitis, fracture of the skull, brain injury and tumor. By gross cerebral disease, I mean disease visible to the naked eye. I presume that microscopic changes of one kind or another are always present, unless it be in the early months or years of the disease. Late changes indicate the seat of insult; they are not the cause of the primary symptoms.

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* Read before the Philadelphia Neurological Society, Jan. 27, 1922.

It is possible that some time in the future epilepsy will cease to be regarded as a disease, just as dropsy and palsy ceased to be so regarded when their causes were discovered, but at the present time, though we know nothing of its cause and nothing definite of its morbid anatomy, it has such a characteristic symptomatology and clinical course that we are justified in still regarding it as an entity.

My data as to family morbidity are necessarily incomplete, because the members of any generation never have full knowledge of the medical history of the family, even of the parents, and either know nothing of the grandparents or only some startling and usually inaccurately remembered fact. Usually little is known about the infantile ailments of brothers and sisters, and if insanity or criminality is known to have occurred in the family, it is often denied. No study of heredity can be thorough unless accurate and complete biographies of at least three generations are known. When, in this paper, for example, I consider the diseases of the children of epileptic parents, conclusions must be formed with care because we do not know how many children there were, because many of the women are still well within the childbearing period, many others are too young to have had children, and not a few are unmarried and we know nothing of their childbearing history. Further, many of the children are far too young to exclude the possibility of epilepsy occurring later, and, of course, years too young to show the influence of parental disease in causing diseases which only appear in later life. Fortunately, however, the errors are of necessity those which minimize the influence of heredity. Thus, should all the children in this group live to middle life, let alone old age, and could we follow them, the number who would develop epilepsy, as well as other diseases, would be larger than is shown here.

It has been believed for centuries that the children of epileptic persons are more prone to epilepsy than others, but the scientific study of inheritance began only in recent times. Before taking up the examination of my own statistics I will quote a few opinions from literature. Gowers states that an inherited tendency (to epilepsy or insanity) is traceable in 35 per cent. of the cases. He doubts whether any inherited morbid state outside the nervous system predisposes to epilepsy and specifically denies that phthisis does. He notes that idiopathic epilepsy sometimes occurs in subjects with inherited (he means congenital) syphilis when no other cause is traceable. Bernard Sachs and Leonard Guthrie speak of the close association of epilepsy and chorea in families, and Osler mentions it incidentally. William A. Turner writes: "The most common cause of epilepsy is ancestral epilepsy, but other neuropathic conditions, such as insanity and parental alcoholism, may be added. A careful inquiry into the parental history may give evidence of an hereditary neurosis, such as periodic headache, bilious attacks, neurasthenia, hysteria, or tics, while evidence of unsuspected or unrecognized epilepsy is often forthcoming." R. Gaupp regards "degeneration as the most important cause of genuine epilepsy." He lays stress on ancestral migraine and parental alcoholism as important predisposing causes.

EPILEPSY AND CONDITIONS CONDUCIVE TO EPILEPSY IN RELATIVES OTHER THAN OFFSPRING

Let us take up the statistical matter. The patients were all in attendance at the clinics of the Orthopaedic Hospital and Infirmary for Nervous Diseases. The histories of 442 of 1,891 patients were so fragmentary as to be valueless, leaving 1449 on which to work.

First as to the frequency of epilepsy in relatives other than offspring: The records show: father, 14; mother, 17; aunt, 14; uncle, 15; brother, 17; sister, 22; grandmother, 9; grandfather, 3; granduncle, 1; great grandmother, 1; first cousin, 13; making a total of 126 cases in which only one other member of the family than the patient was affected.

In addition there were the following instances of multiple occurrence in the family: aunt, cousin and brother, 1; grandfather and grandaunt, 1; uncle and aunt, 1; grandmother and aunt, 1; four maternal uncles, 1; two cousins (siblings), 1; mother's brother and niece, 1; father and cousin, 1; father, two brothers, three sisters, 1; paternal and maternal aunt, 1; maternal grandfather and paternal uncle, 1; twin brothers, 1; mother, brother, sister, 1; maternal and paternal first cousins, 1; two brothers and one sister, 1; maternal aunt and cousin, 2; uncle and cousin, 1; sister and cousin, 1; brother and maternal uncle, 1; maternal great grandmother, maternal grandmother, maternal aunt and sister, and patient's father had convulsions for a short period when 12 years old, 1; two of father's first cousins, 1; and both paternal grandparents, 1. To sum up: There were (excluding the children of epileptic persons) 193 relatives who are known to have had epilepsy. Of course, there were an unknown number of relatives who suffered from the disease but whose illness was not known to our informants, and consequently the actual incidence was larger than our records show.

One hundred and sixty-five relatives other than offspring were known to have had infantile convulsions not followed by epilepsy. They are listed as follows: one sister, 31; one brother, 28; mother, 11; father, 6; paternal aunt, 1; paternal aunt and uncle, 1; maternal uncle, 2; paternal uncle, 1; two brothers and one sister, 1; one brother and one sister, 1; two siblings, 3; two brothers, 4; three brothers and one sister, 1; five siblings, 1; three siblings, 3; five brothers and one sister, 1; two sisters, 1; six siblings, 1; paternal uncle and two brothers, 1; cousin, 1; sister and brother, 4; one brother and four sisters, 1; eight siblings, 1; mother and uncle, 1; father and first cousin, 1; father, paternal aunt and uncle, 1. Ninety-one of the children died in or in consequence of convulsions. It was impossible to determine the causes of the convulsions in such a large number that the remainder was too small to use in drawing conclusions.

The relatives of thirty-six patients are recorded as insane, the distribution being as follows: father, 2; mother, 11; brother, 6; sister, 4; aunt, 4; uncle, 3; first cousin, 1; half-brother, 1; grandfather, 3; grandmother, 1. The following cases of multiple incidences occurred: two maternal uncles (father attempted suicide), 1; two first cousins, 1; aunt and grandaunt, 1; and grandmother insane and epileptic, 1. An inevitable error in the statistics of insanity is the fact that a family rarely realizes, and still more rarely admits, the existence of that disease until and unless the victim is sent to a hospital, and therefore the real percentage in my patients was higher than the figures indicate. Many people with hypomania or imbecility are believed by their relatives to be mentally well or, at worst, eccentric.

Cases of suicide and homicide are recorded as follows: One mother committed homicide; one father killed his father-in-law and himself; two mothers, five fathers, one sister and one of two brothers with melancholia committed suicide; and one father attempted it.

Chorea is recorded in relatives much more frequently than I expected would be the case. There were sixty-two cases recorded, classified thus: father, 3; mother, 7; sister, 13; brother, 9; uncle, 2; aunt, 4; children, 5; two brothers, 2; two sisters, 1; mother and sister, 2; father and sister, 1; father and brother, 1; mother and brother, 1; two aunts, 1; second cousin, 1. Tic was seldom mentioned, not, I think, because relatives call it chorea, but because the common habit spasm of children, and it is the most frequent type of tic, is not regarded seriously enough to be recalled years later. I am, nevertheless, convinced that tic is a serious sign of inherent instability.

DISEASE IN CHILDREN OF EPILEPTIC PERSONS

The records as to the occurrence of disease in the children of epileptic persons are very incomplete, and many of the women were still of childbearing age. (Of 128 married women under 40, 49 were between 19 and 29 years of age and 59 between 30 and 39.) The children already born varied in age from early infancy to middle life. In order to have accurate records it would be necessary to trace the history of the children until death. However, four children had had chorea, one also had epilepsy; six, epilepsy; and nine had had infantile convulsions. How many of them will become epileptic patients is impossible to foretell. The records as to imbecility are too fragmentary to be of any value.

The causes of death in the children of epileptic persons as recorded were about the same as in the general population. There were 123 deaths in infancy, 20 miscarriages, 18 stillbirths and 3 craniotomies. In ninety cases the cause of death was unknown. There were 443 children living, of whom 278 had epileptic fathers and 205 epileptic mothers. No conclusions can be drawn either from the number of children who lived or from the number who died, except that apparently a child with an epileptic father has a somewhat better chance to survive infancy than one with an epileptic mother.

Alcoholism and Epilepsy.—Much has been written about the relationship between parental alcoholism and epilepsy. My list records 155 fathers who were drunkards, eight cases in which both parents were drunkards, but only two in which the mother alone was a heavy drinker. Lists similar to this have often been used to prove that alcoholism alone, in the absence of all other causes, in the parent causes epilepsy in the offspring. The conclusion is, however, a little too hastily drawn. Students who approach the study of alcoholism from a philosophic point of view know that there are drunkards and drunkards. A craving for alcohol, and the same is true of other drugs, may in itself be a sign of degeneracy. The boy who during adolescence begins to drink and does so because he gets sensations from the drug a normal boy does not get, is inherently a different person than the middle aged man who, having retired from business and lacking intelligence enough to find occupation, sits about and drinks and continues to drink until he gets cirrhosis of the liver. The periodic drinker, who in many ways resembles the psychic epileptic, and who often has great mental ability, belongs in still another category. The man, and there are such, who can drink to drunkenness, sleep it off and be clear minded and hard working next day and continue this for years is still another type. My statistics, and all others I have read concerning alcoholism, fail to make any distinction, and for a very good reason: It is impossible in hospital cases to make a thorough study of the relatives of the patient, and hence the records simply state whether or not the parents drink. Further, the personal equation of the examiner influences the record. What I would record as moderate drinking another might consider to be extreme and incurable alcoholism. The widely varying conclusions drawn by different writers using statistical material, in studying the question of alcoholism, is a classical example of proving anything from figures. The truth probably is that parental alcoholism is not the cause of epilepsy in the offspring, but is frequently a symptom of an inherent abnormality in the family, which in the parent shows itself in one way, in the offspring in another. If parental alcoholism were the cause of epilepsy, it would be a much more common disease. Whether heredity plays a large or small part in the production of the common drunkard, certainly the resemblance of the clinical picture in the periodic drinker, who at regularly or irregularly recurring intervals changes in personality, to the epileptic with his recurring fits, is not accidental; it means that both have an unstable organization, which surely is often inherited. I am not sure, even, that alcoholism is any more frequent in the families of epileptic persons than in other families. There are not, and there cannot be, any accurate statistics regarding the matter.

Phthisis and Epilepsy.—Whether there is any causal relation between parental or family phthisis and epilepsy in children is a difficult problem to solve. In my list 55 fathers, 31 mothers, 1 brother in eleven cases and 1 sister in nine, had phthisis. There were two cases in which 2 brothers, four cases in which 2 sisters, and one case in which 3 sisters were affected. In three cases both parents were tuberculous and in one case 4 siblings. There were thirty-four cases in which more than one of the immediate family had phthisis. This does not seem to be a larger percentage than is found in the general population. It is true that many more of the parents of the epileptic persons here studied had phthisis than had epilepsy, so that if mere occurrence in two generations proved heredity, phthisis would be a much greater factor than epilepsy itself. But epilepsy is only one of the nervous disorders which lay the ground for epilepsy or give the danger signal that it may occur. Insanity, certain types of alcoholism, chorea, all must be added together in summing up hereditary influence. Phthisis is a disease in kind unlike all of these. It cannot be added to them. That there is an inherited predisposition to it and also a natural immunity is undoubted, but that predisposition to disease of the lungs, in the parent, can, in the child, be transformed to a predisposition to epilepsy, is far from proved.

Frequency of Death of Children of Epileptic Parents.—I have made a list of cases in which more than one sibling of an epileptic parent died in infancy, because too frequent deaths among children in families already having a disease in the family, points toward (it does not prove) some weaknesses in one or both parents, inherent or acquired. Of course, infectious infantile diseases may affect any family, barring the naturally immune, but if in any one family in which there exists a disease, for example, phthisis or epilepsy, death from other causes than infectious fevers is frequent in the young, it is some evidence of a general weakness. There were 46 cases in which 2 siblings died in infancy, 29 in which 3 died, 26 in which 4 died, 18 in which 5 died, 9 in which 6 died, 3 in which 7 died, 3 in which 8 died and 1 in which 9 died. It was impossible to get accurate statistics as to stillbirths and miscarriages. Any conclusion drawn from the number of deaths occurring in offspring would be a guess because we have no statistics of the incidence of deaths of children in families in the general population. My impression is that the juvenile death rate in my epileptic families is high.

I have been impressed by the infrequency with which migraine is mentioned. It is common, one of the commenest of diseases, and yet so rarely is it mentioned that I have not recorded the number of cases in which it was given as a symptom, because any conclusion drawn would be fallacious. The probable explanation is that it is such a common ailment people forget all about it.

COMMENT

Can we, from this long catalogue of terrible abnormalities (621 cases of serious nervous and mental disease) occurring in relatives of epileptic persons, a catalogue that is duplicated in the case histories of every hospital, draw any conclusion as to heredity in epilepsy? My statistics do not show that direct inheritance is important, since only thirty-four parents were known to be affected. On the other hand, the frequency of insanity, crime, chorea, alcoholism and epilepsy in relatives points toward congenital instability resulting from abnormality in the germ cell or sperm cell. Considering all the data, it is safe to assume that the effect of heredity is rarely direct, that usually it is indirect and general, not specific. In other words, a predisposition to nervous or mental disease is inherited; the resulting specific disease depends on external causes—it is environmental in the broadest meaning of the word.

What organ or organs are hereditarily at fault in epilepsy? One theory is that the motor cells in the brain are inherently overirritable and hence react violently to stimuli to which normal cells would be indifferent. If epilepsy consisted only in a succession of convulsions, this explanation would suffice. But the convulsion is only one symptom of the disease. Therefore the area of the brain affected must be wider than the motor cortex. Another theory is that because of disorders in the chemistry of the body, the whole brain is more or less affected and because antidotes are also formed the convulsion occurs only when the poison overwhelms the antidote. We do not know what the disorder in metabolism is and what organs are directly involved. Some writers assume that the ductless glands, of which we are hearing so much and being taught something, are primarily at fault. This opinion is based on hypothesis. The most recent hypothesis, that the convulsions are psychogenic in origin and are a defense reaction of the subsconscious mind against an unpleasant situation, needs much more evidence than has been brought to its support. I suspect that biologic chemists rather than psychiatrists will solve the riddle.

INTRAVENOUS ADMINISTRATION OF IODIDS *

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Early in 1919, Weed and McKibben [1] presented the results of investigations which they had made on animals as to the value of hypertonic solutions of sodium chlorid in relation to cerebrospinal fluid pressure. They first observed an increase of salt in the spinal fluid.

With the various solutions the following observations were noted: A hypotonic solution (distilled water) caused an immediate rise in cerebrospinal fluid pressure. Ringer's solution (sodium chlorid, 0.9 per cent.; potassium chlorid 0.042 per cent.; calcium chlorid, 0.025 per cent.) caused an immediate rise but a fall again to normal within eighty minutes. Hypertonic sodium chlorid solutions caused an immediate rise and then a fall to below zero with a slow and gradual return to normal. An 18 per cent. sodium bicarbonate solution caused a fall to zero with a very slow return to normal. A 30 per cent. sodium sulphate solution manifested a slight rise, then a fall to below 50 mm. with a slow and gradual return to normal.

At the same time they observed a distinct alteration in the bulk of the brain by using hypertonic solutions of sodium chlorid. Their experiments were made on animals with the skull both opened and unopened. The brain was seen to fall away several millimeters from the inner surface of the skull after each injection.

During the past four years I have observed three cases of systemic fungus disease (oidiomycosis); in two of the three cases the budding oidium was obtained from the spinal fluid, and the patients were treated with iodids. The first case [2] could be kept under control only with very large doses of potassium iodid (by mouth), and in due time it was necessary to withdraw them because of the distressing symptoms of iodism. The patient was quite well for some time before his death from influenzal pneumonia.

On the recognition of the second case as one of oidiomycosis the oral treatment was replaced by the intravenous, and a hypertonic solution of sodium iodid was given. There was an immediate subsidence of the symptoms. At the time of the latest reports the man was perfectly well.

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* Presented before the New York Neurological Society, Dec. 6, 1921.

[1] Weed and McKibben: Pressure Changes in Cerebro-Spinal Fluid Following Intravenous Injection of Solutions of Various Concentrations. Experimental Alteration of Brain Bulk, Am. J. Physiol. **48**:512-558, 1919.

[2] Farnell, F. J.: Systemic Oidiomycosis with Manifestations in the Central Nervous System, Boston M. & S. J. **176**:771-773, 1917.

The patient in the third case, a girl of 13 years, seen by the examiner last spring, presented cutaneous and bone lesions resembling very closely oidiomycosis, but considered syphilitic by previous practitioners. She had been treated with mercury and iodids by mouth for several months, but made no great progress. Evidently sufficient treatment with iodids had been given to disturb the possibility of obtaining the oidium in pure strain. However, the Wassermann reaction was negative, and the poor response to antisyphilitic treatment led the author to give an intravenous injection of hypertonic sodium iodid. The lesions were healed in forty-eight hours, and the patient remained perfectly well up to date (six months).

Recognizing the value of intravenous hypertonic iodids in the treatment of oidiomycosis, during the past two years at least 400 intravenous injections of hypertonic iodids have been given, and observations have been made on the value of this iodin therapy.

A great deal of attention is being paid to the relation of either organic or inorganic iodin and the thyroid gland. It has been used in vitamin experiments by Emmett, Allen and Sturtevant.[3]

Kendall and Richardson [4] have determined the iodin content in the blood. Osborne [5] has determined the iodin content in the spinal fluid.

In the 1921 volume of "New and Nonofficial Remedies," [6] as accepted by the Council on Pharmacy and Chemistry of the American Medical Association, it is stated in regard to iodin compounds for internal use:

> These are typified by the ordinary iodides. The mechanism of their action is not understood. The most definite results are seen in the rapid absorption of certain inflammatory exudates and especially of the tertiary lesions of syphilis (gummas); lesions of the bone, skin, brain, or other internal organs, disappear under adequate doses of the drug. Likewise in actinomycosis and sporotrichosis the action of iodine as iodide is almost specific. The iodides are not germicidal.
>
> The effect of iodides in arteriosclerosis and aneurysm is probably limited to the absorption of syphilitic deposits in the vessel wall. The iodides do not directly lower blood-pressure. They increase the amount of iodothyrin and may thus have indirect effects on metabolism.
>
> A striking innovation in iodide therapy has been the introduction of compounds of iodine with proteins and fats. The advocates of these organic

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[3] Emmett, Allen, and Sturtevant: Relation of Vitamines and Iodine to the Size and Development of Tadpoles, J. Biochem. **41:** No. 3, p. 54 (Proceedings).

[4] Kendall and Richardson: Estimation of Iodine in the Blood, J. Biochem. **42:**149, 1921.

[5] Osborne, Earl D.: Iodin in the Cerebrospinal Fluid with Special Reference to Iodid Therapy, J. A. M. A. **76:**1384-1386 (May 21) 1921.

[6] New and Nonofficial Remedies, Chicago, American Medical Association, 1921, p. 150.

combinations assert that they are less irritating to the digestive tract and that they are less inclined to set up the disagreeable symptoms of iodism, for instance, coryza and skin eruptions. Experience confirms in a measure the former claim, but the latter is misleading. Iodism is probably a necessary manifestation of the full physiologic activity of the drug, which is required for the treatment of syphilis and other diseases. If, therefore, a preparation fails to elicit these characteristic symptoms, we conclude that the amount of the drug absorbed is insufficient. Clinical observations show that the organic iodides, in the dosage ordinarily employed, are weaker than the metallic forms.

It is observed that the percentage of iodin is greatest in ammonium iodid, 87.5 per cent.; next in sodium iodid, 84.6 per cent, and next in potassium iodid, 76.4 per cent.

I have used sodium iodid exclusively in my work. Sodium iodid has been used because of the nonactivity of the sodium ion. The preparation is made in from 8 per cent. to 15 per cent (10 per cent. is the usual rate) solutions in distilled water, which is also autoclaved—amount, 100 c.c. This is then boiled and cooled and given by gravity intravenously (made fresh for each treatment). A distinctly hypertonic solution of high concentration is thus produced.

By this method of high concentration and its immediate introduction into the blood stream, in none of the examiner's observations has there been any irritation of the digestive tract. Skin eruptions were observed in one case (no coryza). Coryza (no skin eruptions) was observed in one case.

The patients made such comments as the following: A brassy taste may make itself manifest during the period of injection and from then up to and including three days. This may mean that the iodin is not eliminated completely for about three days. Several patients have referred to the odor of their perspiration which will last for about two days. Within the first twenty-four hours after the introduction of iodin some patients will have a profuse copious stool, dark colored and odorous.

Strange as it may seem, the odor of the perspiration and the copious stool production has occurred only in those cases in my group in which the symptoms were related to alcoholism and in which there were definite indications of cerebral edema.

In patients with syphilis (cerebrospinal) in whom the liver was undoubtedly attacked, the gastro-intestinal complaints and the hypochondriac distress abated soon after treatment. It is a fact that iodin is capable of increasing autolysis, especially in the liver.

Striking results have been observed in those cases in which there is a presumed increase in the bulk of the brain—cerebral thrombosis, cerebral hyperemia, cerebral edema, etc. Weed and McKibben believe that the brain should no longer be considered as incompressible or of fixed volume, but that it is subject to variation in size. The cranial cavity is fixed in volume and contains a brain, blood and cerebrospinal fluid. Variations in any one may occur, compensation being afforded by an alteration in the volume of one or both of the remaining elements.

Among my patients, one with cerebral hyperemia received relief from headache and ocular symptoms after the introduction of a 10 per cent. solution of iodid. A patient with cerebral edema, cardiovascular, with a convulsion and resultant hemiplegia, received five injections of a 10 per cent. solution at four-day intervals, which was followed by a rapid readjustment of his cerebral disorder.

Patients with cerebrospinal syphilis, of the meningitic and meningovascularis types, appear to respond more rapidly to arsphenamin treatment by receiving occasional injections of 10 per cent. sodium iodid. Iodin being a reducing agent, it probably increases the permeability of the cells of the meninges.

High blood pressure has not been reduced, but a distinct change in the general metabolism of the patients occurs.

COMMENT

1. Do tissue and cell changes occur more rapidly when a highly concentrated solution of sodium iodid is injected directly into the blood stream?

2. Could the same result be obtained by giving a concentrated solution with a bland syrup, by mouth?

3. Does the apparently good result depend on the high concentration or on the intravenous channel of administration?

SUMMARY

Iodin in the form of an iodid can be given in hypertonic form intravenously.

Iodin when injected into the blood stream in hypertonic form has a tendency to reduce the idiosyncrasy toward iodism.

Iodids introduced into the blood stream appear to readjust systemic fungus disturbances (oidiomycosis) very rapidly.

Iodids injected intravenously in concentrated form appear to help materially the action of arsphenamin on the diseased tissues and cells.

Iodids introduced into the blood stream in hypertonic solutions probably have some influence on reducing the edema, hyperemia, etc., of the brain in increased brain bulk disorders.

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SEROLOGIC CHANGES IN NEUROSYPHILITIC PATIENTS DURING A PERIOD OF NONTREATMENT *

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AND

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MENDOTA, WIS.

A selected group of paretic patients was studied during a period of over six months, during which time no specific medication was administered. This to our knowledge has not been done before. The patients selected for this investigation had not received any treatment for several years. All cases were under constant supervision, and careful periodic mental and physical examinations were made. The patients were carefully chosen according to their mental and physical findings and had undoubted cases of paresis.

In paretic patients, laboratory findings frequently change during a period of specific treatment, and such changes are quite generally accepted as a result of the treatment. Our serologic investigation was made by a method which we believe gives constant results. This method shows degress of positive reaction and hence permits a comparison of findings over an extended period.

The laboratory procedures were: Wassermann titration of blood serum by a titration method developed by Dr. W. F. Lorenz, Director of the Wisconsin Psychiatric Institute (personal communication to be reported later); Wassermann titration of cerebrospinal fluid by the same method; a cell count; Lange's colloidal gold test, and the Ross-Jones and Noguchi tests for globulin.

In the Wassermann tests the antihuman system was employed throughout. Fresh pooled guinea-pig serum was used as complement; serum from immunized rabbits was used as amboceptor. Noguchi's acetone-insoluble extract of human heart muscle was used as antigen. The antigen used was neither anticomplementary nor hemolytic in ten times the amount used in the test and the dose employed was 0.1 c.c. of a 10 per cent. dilution which was four times the amount required to give a positive reaction with pooled syphilitic serum.

TECHNIC OF THE WASSERMANN TITRATION ON BLOOD SERUM

Test-tubes are set up in four rows as follows:

Row A: To determine the amount of native complement present in the serum. Measured amounts of diluted unheated serum are employed throughout.

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* From the laboratories of the Wisconsin Psychiatric Institute.

Row B: Serum plus 1 unit complement.
Row C: Antigen plus 1 unit complement.
Row D: Antigen plus 2 units complement.

After withdrawal the blood is allowed to clot at room temperature and then placed in the icebox for twenty-four hours. After centrifugation the serum is prepared in the following dilutions 2.5, 5, 10, 20 and 50 per cent., and 0.1 c.c. of each dilution is used in the test. Table 1 illustrates the method.

TABLE 1.—Wassermann Titration of Blood Serum

D	1 c.c. of 2.5% serum Antigen 2 units complement	1 c.c. of 5% serum Antigen 2 units complement	1 c.c. of 10% serum Antigen 2 units complement	1 c.c. of 20% serum Antigen 2 units complement	1 c.c. of 50% serum Antigen 2 units complement
C	1 c.c. of 2.5% serum Antigen 1 unit complement	1 c.c. of 5% serum Antigen 1 unit complement	1 c.c. of 10% serum Antigen 1 unit complement	1 c.c. of 20% serum Antigen 1 unit complement	1 c.c. of 50% serum Antigen 1 unit complement
B	1 c.c. of 2.5% serum 1 unit complement	1 c.c. of 5% serum 1 unit complement	1 c.c. of 10% serum 1 unit complement	1 c.c. of 20% serum 1 unit complement	1 c.c. of 50% serum 1 unit complement
A	1 c.c. of 2.5% serum	1 c.c. of 5% serum	1 c.c. of 10% serum	1 c.c. of 20% serum	1 c.c. of 50% serum

One c.c. of 1 per cent. corpuscle suspension is added to each tube and the series is incubated for one hour at 37.5 C. Amboceptor is then added, and the series is again incubated with frequent shaking of the tubes during the last incubation period.

TECHNIC OF THE WASSERMANN TITRATION IN THE CEREBROSPINAL FLUID

Row A: Control plus 1 unit of complement.
Row B: Antigen with 1 unit of complement added.
Row C: Antigen with 2 units of complement added.

Since cerebrospinal fluid does not contain native complement only three rows of tubes are necessary, one for control and two for antigen. The cerebrospinal fluid is used in the following dilutions: 5, 10, 20 and 50 per cent.; of these 0.1 c.c. is used in each tube. A series containing 0.1, 0.3 and 0.5 c.c. of undiluted fluid is included in the test.

Table 2 illustrates the set up for the titration in the spinal fluid.

One c.c. of 1 per cent. corpuscle suspension is added to each tube, the series incubated for one hour at 37.5 C., and at the end of the first hour's incubation, an amboceptor unit is added, and the series is again incubated for an hour with frequent shaking of tubes.

TECHNIC OF DAILY TITRATIONS FOR COMPLEMENT UNITS

A series of four rows of test-tubes are set up as follows:

Row A contains 1 c.c. of 1 per cent. corpuscles with a dose of amboceptor, and varying amounts of 10 per cent. fresh pooled guinea-pig serum.

Row B: Same as row A with the addition of nonactive negative serum.

TABLE 2.—Wassermann Titration in the Cerebrospinal Fluid

	1 C.c. Spinal Fluid in Dilutions of				Undiluted Spinal Fluid		
	5%	10%	20%	50%	0.1 C.c.	0.3 C.c.	0.5 C.c.
C	Antigen 2 units complement	Antigen 2 units complement	Antigen 2 units complement	Antigen 2 units complement	Antigen 2 units complement	Antigen 2 units complement	Antigen 2 units complement
B	Antigen 1 unit complement	Antigen 1 unit complement	Antigen 1 unit complement	Antigen 1 unit complement	Antigen 1 unit complement	Antigen 1 unit complement	Antigen 1 unit complement
A	1 unit complement	1 unit complement	1 unit complement	1 unit complement	1 unit complement	1 unit complement	1 unit complement

TABLE 3.—Daily Titrations for Complement Units

D	0.1 c.c. antigen 0.04 c.c. serum 1 c.c. 1% corpuscles 1 unit amboceptor 0.05 c.c. 10% complement	0.1 c.c. antigen 0.04 c.c. serum 1 c.c. 1% corpuscles 1 unit amboceptor 0.1 c.c. 10% complement	0.1 c.c. antigen 0.04 c.c. serum 1 c.c. 1% corpuscles 1 unit amboceptor 0.15 c.c. 10% complement	0.1 c.c. antigen 0.04 c.c. serum 1 c.c. 1% corpuscles 1 unit amboceptor 0.2 c.c. 10% complement
C	0.1 c.c. antigen 1 c.c. 1% corpuscles 1 unit amboceptor 0.05 c.c. 10% complement	0.1 c.c. antigen 1 c.c. 1% corpuscles 1 unit amboceptor 0.1 c.c. 10% complement	0.1 c.c. antigen 1 c.c. 1% corpuscles 1 unit amboceptor 0.15 c.c. 10% complement	0.1 c.c. antigen 1 c.c. 1% corpuscles 1 unit amboceptor 0.2 c.c. 10% complement
B	0.04 c.c. neg. serum 1 c.c. 1% corpuscles 1 unit amboceptor 0.05 c.c. 10% complement	0.04 c.c. neg. serum 1 c.c. 1% corpuscles 1 unit amboceptor 0.1 c.c. 10% complement	0.04 c.c. neg. serum 1 c.c. 1% corpuscles 1 unit amboceptor 0.15 c.c. 10% complement	0.04 c.c. neg. serum 1 c.c. 1% corpuscles 1 unit amboceptor 0.2 c.c. 10% complement
A	1 c.c. 1% corpuscles 1 unit amboceptor 0.05 c.c. 10% complement	1 c.c. 1% corpuscles 1 unit amboceptor 0.1 c.c. 10% complement	1 c.c. 1% corpuscles 1 unit amboceptor 0.15 c.c. 10% complement	1 c.c. 1% corpuscles 1 unit amboceptor 0.2 c.c. 10% complement

Row C: Same as row A with one antigen unit.

Row D: Same as row A with antigen unit and nonactive negative serum.

Table 3 illustrates the set-up for the daily complement titration.

One c.c. corpuscles 1 per cent. and 1 dose amboceptor is added to each tube.

Two titrations are made. In one the amboceptor is added immediately, in the other titration the amboceptor is added after one hour's incubation—after the addition of amboceptor in both of these titrations the series is incubated at 37.5 C. for one hour. The tube showing complete hemolysis with the least amount of complement is considered as the unit for that day. The result in the titration made with immediate addition of amboceptor must not vary beyond one tube from the result obtained with the titration in which the amboceptor was added at the end of one hour. Likewise the unit obtained with the hemolytic system must not vary beyond one step from that in which antigen or antigen and negative serum are present. This procedure serves as a careful check on any anticomplementary properties that may develop in a stock antigen.

TABLE 4.—Findings in Wassermann Titration of Blood

	1 C.c. Serum in Dilutions of				
	2.5%	5%	10%	20%	50%
Initial observation:					
D	H	H	H¼	+	+
C	H	H¼	+	+	+
A	+	+	H¼	H½	H¾
After an interval of 1 week:					
D	H	H	H	+	+
C	H	H	+	+	+
A	+	+	+	+	H¼
After an interval of 2 weeks:					
D	H	H	H	+	+
C	H	H	H¾	+	+
A	+	+	H¼	H½	H¾
After an interval of 3 weeks:					
D	H	H	H	+	+
C	H	H	H	+	+
A	+	+	H¼	H¼	H½
After an interval of 4 weeks:					
D	H	H	H¼	+	+
C	H	H	+	+	+
A	+	+	+	+	H¼
After an interval of 5 weeks:					
D	H	H	H	+	+
C	H	H½	H¼	+	+
A	+	+	+	H½	H¾
After an interval of 7 weeks:					
D	H	H	H¾	+	+
C	H	+	+	+	+
A	+	+	+	H¼	H½
After an interval of 9 weeks:					
D	H	H	+	+	+
C	H	H¾	+	+	+
A	+	+	+	H¾	H
After an interval of 13 weeks:					
D	H	H½	H¼	+	+
C	H	+	+	+	+
A	+	+	+	H¼	H½
After an interval of 17 weeks:					
D	H	H	H½	+	+
C	H	H	+	+	+
A	+	+	+	H¼	H½
After an interval of 31 weeks:					
D	H	H	H½	+	+
C	H	H	+	+	+
A	+	+	+	H¼	H½

REPORT OF CASE

History.—A white man, 38 years old, single, a manufacturer of restraints, had a syphilitic infection nine years ago, after which he took mercury pills for two years. The onset was gradual, characterized by delusions of persecution three years prior to admission.

The patient was admitted to the Wisconsin State Hospital at Mendota, Wis., March 11, 1918.

Mental Examination.—On admission the patient was elated, exalted and grandiose. During examination he was very irritable, restless, easily annoyed and showed poverty of ideas and delusions of persecution. Emotional exaltation, marked intellectual deterioration and defective memory were present.

Physical Examination.—The patient was apparently strong and healthy. His thyroid was palpable, his heart and lungs negative. The blood pressure was: systolic 134 and diastolic 78. He weighed about 120 pounds (54 kg.).

TABLE 5.—Findings in Wassermann Titration of Spinal Fluid

	1 C.c. Spinal Fluid in Dilutions of				Undiluted Fluid		
	5%	10%	20%	50%	0.1 c.c.	0.3 c.c.	0.5 c.c.
Initial observation:							
C	H	H	H	+	+	+	+
B	H	H	+	+	+	+	+
After an interval of 2 weeks:							
C	H	H	H	H¼	+	+	+
B	H	H	+	+	+	+	+
After an interval of 5 weeks:							
C	H	H	H	+	+	+	+
B	H	H	H	+	+	+	+
After an interval of 9 weeks:							
C	H	H	H	H½	+	+	+
B	H	H	H	+	+	+	+
After an interval of 13 weeks:							
C	H	H	H	H½	+	+	+
B	H	H	H½	+	+	+	+
After an interval of 17 weeks:							
C	H	H	H	H½	+	+	+
B	H	H	H½	+	+	+	+
After an interval of 30 weeks:							
C	H	H	H	H	+	+	+
B	H	H	H	+	+	+	+

TABLE 6.—Results of Colloidal Gold, Cell Counts and Globulin Tests

	Colloidal Gold Test	Cell Count	Ross-Jones and Noguchi Tests
Initial test	5555555210	35	+
After an interval of 2 weeks	5555555210	35	+
After an interval of 5 weeks	5555554210	33	+
After an interval of 9 weeks	5555432100	21	+
After an interval of 13 weeks	5555542100	30	+
After an interval of 17 weeks	5555553100	28	+
After an interval of 30 weeks	5555554100	21	+

Neurologic Examination.—The patient had no anosmia. His pupils were irregular, miotic and equal; they reacted to accommodation and sluggishly to light. Marked tremor of the facial muscles, tongue and hands was present. The tendon reflexes were hyperactive. The superficial reflexes were normal. Pathologic toe findings were present on both sides; there were no definite sensory changes. A slight Romberg sign was present. The gait was good, speech slurring and slow. Writing was tremulous; there were no omissions.

Laboratory Findings on Admission.—These were: Blood Wassermann test + + + +, cerebrospinal fluid test + + + +; colloidal gold test 5555541000; Ross-Jones test, positive; Noguchi test, positive; 29 cells.

Serologic Findings.—Wassermann titration of the blood was made.

In recording the findings over a period of observation only the results of column A (titration for native complement), column C (titration with one unit of complement) and column D (with two units of complement), will be included, it being understood that column B (hemolytic system control) will show complete hemolysis in all tubes. The results are recorded by the following scheme:

H indicates complete hemolysis.
H ¾ indicates hemolysis of approximately ¾ of the corpuscles
H ½ indicates hemolysis of approximately ½ of the corpuscles.
H ¼ indicates hemolysis of approximately ¼ of the corpuscles.
+ indicates no hemolysis (complete inhibition).

Color comparison was used as the guide in determining the grades of partial hemolysis.

Wassermann titration of spinal fluid was also made. Row B shows the result with one unit of complement and row C with two units. The control row is omitted in Tables 5 and 6.

Nine cases in all were similarly studied and eight of the nine gave findings which were uniformly positive in both the blood and cerebrospinal fluid.

One case (No. 109) was diagnosed as paresis in 1914. The patient received antisyphilitic treatment during 1914 and 1915, and the condition might be regarded as clinically arrested. The serologic examinations were negative in this case throughout the period of observation.

CONCLUSIONS

The laboratory findings in a series of nine cases of late neurosyphilis remained practically unchanged during a seven month period of nontreatment.

EPIDEMIC ENCEPHALITIS WITH MYELITIS *

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The spinal cord has been little implicated in epidemic encephalitis and I know of no case except the one I now report in which intense inflammation was found as low as the lumbar region. The case reported in this paper is interesting in its symptoms suggesting brain tumor; in its pathology presenting a myelo-encephalitis; and in the resemblance of its lesions to those of multiple sclerosis, affording support for the theory of the inflammatory origin of the latter disease.

Nuclear stains in this case yielded different findings from those of multiple sclerosis in the intense perivascular infiltration and the presence of many fatty granular or gitter cells in the tissues, and yet it seems reasonable to suppose that had death been delayed a year or more the structure of these sclerotic areas would have resembled that of the areas in multiple sclerosis. The Weigert hematoxylin stain gives findings closely resembling the sclerotic patches of multiple sclerosis, as shown by the illustrations. If we accept the view that fatty granular cells are derived from glia cells and cells in the walls of the blood vessels, as Schröder [1] maintains, we may expect these cells to assume again more the appearance of glia cells in lesions of long duration.

The spinal cord has been found to be implicated in epidemic encephalitis by Harbitz and by Winkelman and Weisenburg.[2] In the case reported by the latter the lesions in the cord were not intense, they were similar in character to those in the brain, and the spinal cord below the middle or lower thoracic region was entirely normal. There were no sclerotic patches.

REPORT OF CASE

History.—I. R. B., a girl, aged 15 years, was admitted to the University Hospital, April 20, 1921. About Feb. 1, 1921, the father noticed that she walked with her head farther forward than usual. She vomited a few times about the first of March and complained of dizziness and headache. The vomiting usually occurred a short time after eating. She complained of the dizziness and headache all the time she was standing. She began to stagger a little in walking, early in March, and appeared as though she might be intoxicated. Later in March it became necessary for her to hold on to objects in walking. Her father noticed that she was becoming dull during the latter part of February, 1921. She did not notice things as she had formerly, and she did not play. She did not seem to understand immediately when spoken to. She did her work as usual, but when she had nothing to do she sat listless, and this languor persisted.

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* Read before the Philadelphia Neurological Society, Feb. 24, 1922.

[1] Schröder: Berl. klin. Wchnschr. **54**:714, 809, 1917.

[2] Winkelman, N. W., and Weisenburg, T. H.: A Case of Myoclonic Lethargic Encephalitis with Unusual Pathologic Manifestations, Phila. Neurol. Soc. Trans., Arch. Neurol. & Psychiat. **5**:224 (Feb.) 1921.

She was taken to St. Luke's Hospital, Bethlehem, and it is not surprising that a diagnosis of cerebellar tumor was made. She began to have a little difficulty in talking in April; she knew what she wanted to say but had difficulty in forming the words. This difficulty rapidly increased. She began to complain of numbness of the right upper and lower limbs early in April, also of numbness of the tongue and some difficulty in swallowing. Her father thought her whole right side had become weak, but this paralysis is uncertain. She had had no convulsions. She still had slight headache when she came to the University Hospital. Constipation had become marked. She had no dyspnea or palpitation. She had difficulty in passing the urine, and at times had to be catheterized. Menstruation was regular up to the time she came to the hospital. A severe attack of scarlet fever had left her deaf in the left ear.

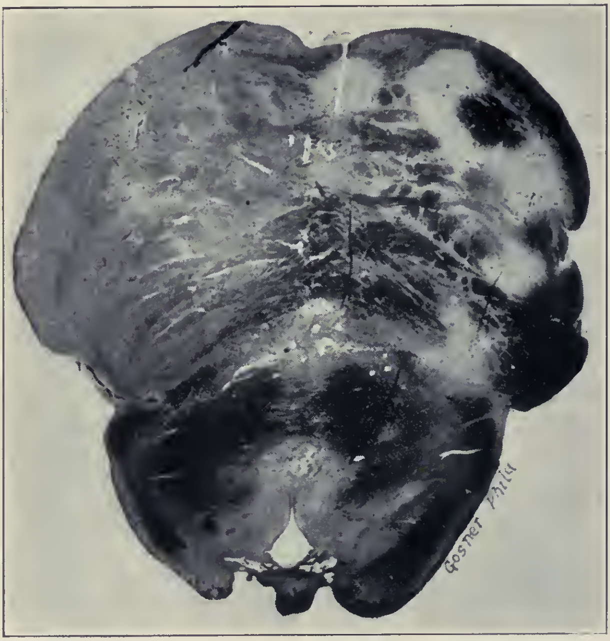

Fig. 1.—Weigert medullary sheath stain of a section of the pons. Sclerotic patches are sharply defined on one side of the raphé, while on the other side the degeneration is more diffuse.

Examination.—When she entered the University Hospital she was lethargic; she answered when spoken to but became tired after answering a few questions, and did not notice what was going on about her. Her articulation was poor. Respiration was normal. The tongue was protruded poorly and deviated to the left. There was little movement of the eyes laterally, but some movement upward with nystagmus, and better downward movement. There probably was bilateral ptosis.

Biceps tendon reflexes were not obtained and the triceps tendon reflexes were slight. The left patellar reflex was moderately exaggerated, and the right was somewhat diminished. Both Achilles reflexes were exaggerated. and bilateral ankle clonus was obtained. In the Babinski reflex there was upward movement of the toes on each side.

The handgrasp was weak on each side. The patient was unable to straighten her fingers, and they were held slightly flexed.

Dr. B. F. Baer found the optic disks sharply marked and the eye-grounds negative.

Notes obtained from Dr. Francis J. Dever, Bethlehem, stated that she had been admitted to St. Luke's Hospital in April, 1921, with nausea, vomiting and headache. The blood Wassermann reaction was negative. An examination of the spinal fluid revealed 3 cells per cubic millimeter. The Wassermann test of the fluid was negative, and Fehling's solution was reduced. The right internal rectus muscle was paralyzed and the external rectus was weak. Similar muscle changes were obtained in the left eye. The only fundus change was slight pallor of the temporal side of the disks.

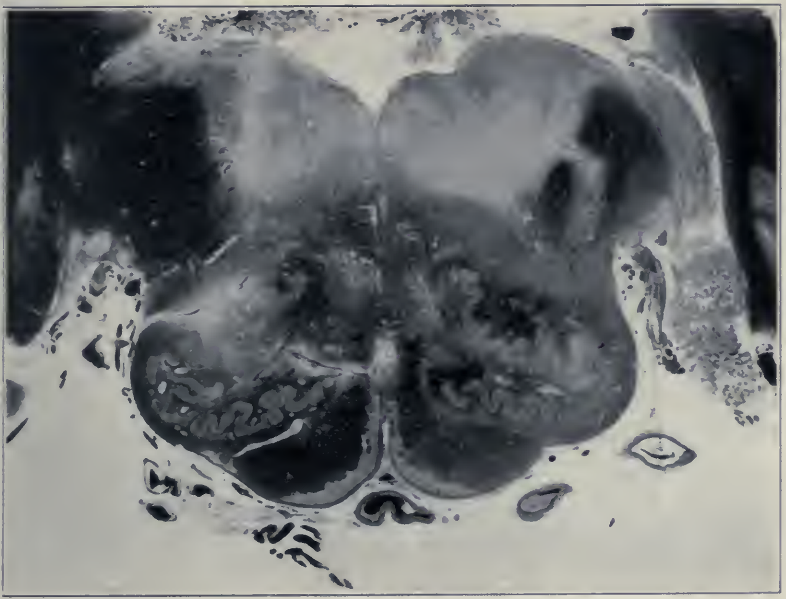

Fig. 2.—Section through the medulla oblongata.

Dr. A. B. Hamilton had found partial ptosis of each upper lid, slight nystagmus on looking to the left, marked nystagmus on looking to the right, and marked nystagmus on looking upward. The left ear was completely dead. Biceps and triceps reflexes were slightly exaggerated, and marked dysmetria was present on each side in the finger to nose test. Diadokokinesia was normal. The upper and lower limbs were not believed to be paralyzed. The gait was of the cerebellar type, and Romberg's sign was marked. Tactile and pain sensations were normal.

On April 24 her mentality was too feeble to permit careful examination, but it was possible to determine that the left lower facial nerve supply was completely paralyzed, and that the upper supply was weak, though she could close the left eyelids. She understood a simple command, such as to show the teeth, and performed this movement several times. She gradually became worse and died May 5, 1921.

The important symptoms in this case were: headache, vertigo, vomiting, mental impairment and lethargy, numbness and possibly weakness of the right limbs, nystagmus, dysmetria, incoordination of gait and station, exaggeration of the tendon reflexes of the lower limbs, the Babinski sign, paralysis of the left seventh nerve and ocular palsies.

A diagnosis of cerebellar tumor was not unreasonable, and certain symptoms suggested multiple sclerosis; but the case appeared to me to be one of epidemic encephalitis, and microscopic study of the tissues proved that this diagnosis was correct.

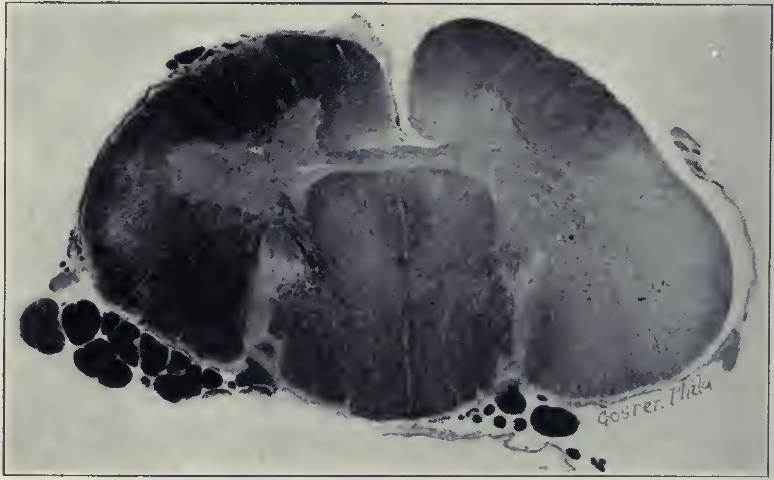

Fig. 3.—Section about the first thoracic segment.

Microscopic Examination.—Sections from the frontal and occipital lobes and the paracentral lobule showed nothing abnormal. The inflammation was of moderate intensity in the basal ganglions, but it was intense in the cerebral peduncles. Here some sclerotic patches were found by the Weigert hematoxylin stain, but they were not so numerous as in the pons and medulla oblongata. The cerebral peduncles were the highest level at which these patches were seen. The characteristic lesions of epidemic encephalitis were pronounced in the cerebral peduncles—the perivascular infiltration of lymphocytes and plasma cells and the diffusion of these cells throughout the tissues, especially in the gray matter below the aqueduct of Sylvius. Occasionally an area was found containing many spaces from which the nerve fibers had disappeared, resembling the areas so common in severe anemia of the spinal cord; in some of these the cellular infiltration was only of moderate intensity.

The pons showed numerous sclerotic patches by the Weigert hematoxylin stain (Fig. 1), resembling closely those of multiple sclerosis as presented by this stain. I have sections from cases of multiple sclerosis stained by this method which would be hard to distinguish from these of epidemic encephalitis. These areas were in places sharply defined like those considered so characteristic of multiple sclerosis. I have found nothing like them in any other case of epidemic encephalitis except a single area in the cerebral peduncles in one case, nor have I seen such areas described in the literature. With thionin or a nuclear stain like Delafield's hematoxylin they showed intense cellular infiltration, consisting of lymphocytes, plasma cells, glia cells and large globular cells with a small nucleus (fatty granular cells or gitter cells), differing from the areas of acute or subacute multiple sclerosis but resembling them. The characteristic lesions of epidemic encephalitis were intense in the pons and medulla oblongata. I have not seen more intense perivascular cellular infiltration in any case of this disease. The medulla oblongata was affected as severely and in the same way as the pons (Fig. 2). The cerebellum showed nothing striking.

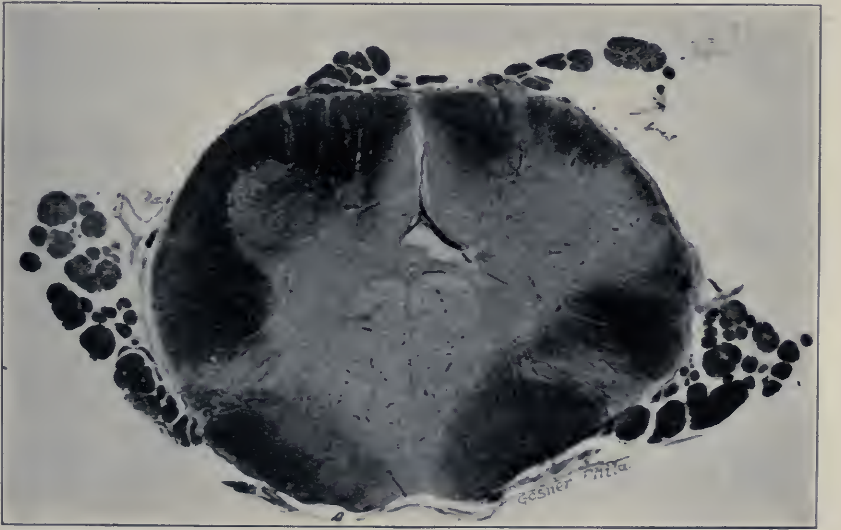

Fig. 4.—Section from the lumbar region showing sharply defined sclerotic areas.

The lower cervical and upper thoracic region (Fig. 3) presented marked sclerotic patches, and they consisted largely of proliferated neuroglia. There was moderate cellular infiltration in these areas but not so intense as in the lumbar region. The degeneration was not confined to any system of fibers, as would be the case in secondary degeneration.

The midthoracic region appeared to be normal, except that in the lateral columns there were one or two areas of very loose neuroglia tissue. This was interesting in view of the great implication of the cervical and lumbar regions, but axis cylinders escaped degeneration, at least partly. It is possible that the spinal inflammation was not of sufficient duration for the development of secondary degeneration.

The midlumbar region (Fig. 4) showed a condition similar to that of the cervical region, but here there was a pronounced cellular infiltration of the gray matter of much the same intensity as in the pons and medulla oblongata, remarkable in its occurrence so low in the cord. I have not seen so grave an implication of the lumbar region in epidemic encephalitis.

ACTINOMYCOSIS OF THE CENTRAL NERVOUS SYSTEM *

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Actinomycosis, while a relatively uncommon disease, has been recognized for years. As early as 1841, it was known to affect man. Some years later Ponfick[1] reported the first two cases of actinomycosis of the brain.

The frequency with which the central nervous system is involved in actinomycosis is difficult to determine. Osler,[2] Lewandowsky,[3] Oppenheim[4] and others report isolated cases and call attention to its rarity. Ruhräh,[5] in 1899, collected sixty-five cases of actinomycosis, nine with involvement of the nervous system. Von Baracz,[6] in 1903, reported sixty cases, in no instance showing involvement of the central nervous system. Cranwell,[7] in an exhaustive investigation in South America, fails to mention cerebrospinal invasion.

The impression gained would be that the central nervous system is markedly free from actinomycotic involvement. However, in a careful review of the literature forty-eight cases of actinomycosis with involvement of the central nervous system have been collected. Sagredo,[8] in 1919, collected twenty cases; they are here included.

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* Presented before the Neurological Surgical Society, Mayo Clinic, Rochester, Minn., Nov. 5, 1921.

[1] Ponfick, E.: Die Actinomykose des Menschen, eine neue Infectionskrankheit, Berlin, Hirschwald, 1882, 138 pp.

[2] Osler, W.: The Principles and Practice of Medicine, New York, Appleton, 1917, 1225 pp.

[3] Lewandowsky, M.: Handbuch der Neurologie, Berlin, J. Springer, 1910, **3**: Pt. 2, p. 216.

[4] Oppenheim, H.: Lehrbuch der Nervenkrankheiten für Aerzte und Studierende, Berlin, S. Karger **2**: 1158, 1913.

[5] Ruhräh, J.: Actinomycosis in Man, with Special Reference to the Cases Which Have Been Observed in America, Ann. Surg. **30**:417-451; 604-631, 721-746, 1899.

[6] Von Baracz, R.: Report of Sixty Cases of Actinomycosis, Ann. Surg. **37**:336-340, 1903.

[7] Cranwell, D. J.: Contribucion al estudio de la actinomicosis humana; su frecuencia en la Republica Argentina, Buenos Aires: Hermanos, 1904, 193 pp.

[8] Sagredo, N.: Actinomycose du cerveau, Rev. méd. de la Suisse Rom. **39**:478-492, 505-516, 1919.

In this group of forty-eight cases, males were more frequently affected than females. The average age of the patients was about 30 years. The duration of the disease ranged from six months to three years; it rarely lasted more than one year. The majority of cases followed actinomycosis of the jaw, the central nervous system being involved by contiguity. The disease may occur primarily in the brain, though this is rare. Meningeal involvement is the usual form, abscess formation is fairly common, while tumor formation is unusual. Involvement by way of the lymphatics has never been noted.

Musser,[9] Sagredo and Corinth,[10] Howard[11] and others have reported on the spinal fluid. Sagredo obtained 70 per cent. of polymorphonuclears and 30 per cent of lymphocytes, while Corinth reports purulent fluid containing streptococci. No mention is made of the early findings nor of when the purulent fluid developed.

Headache played only a slight part in the early symptomatology of the disease, although in several cases marked neuralgic pains over the swelling, especially when it was around the face, were noted. Convulsive attacks and palsies were not uncommon, but presented nothing of diagnostic value. As a rule, the disease had developed to a marked degree before the diagnosis was made. In several cases the diagnosis was made only after finding sulphur granules postmortem. In spite of the severe infection, the temperature was usually low. This afebrile course of the disease was noted as early as 1887 by Bollinger.[12]

SEVENTY-FOUR CASES OF ACTINOMYCOSIS IN THE MAYO CLINIC

The cases reviewed for this study were observed in the Mayo Clinic. In all a positive diagnosis was made microscopically by finding the typical sulphur granules in the pus (Fig. 1). Eighty per cent. of the patients were males, the greater number young adults. The youngest patient was 15, the oldest 71. A large percentage were farmers or were connected with rural life. A history of direct exposure to diseased cattle was rarely obtained. The primary location, so far as could be determined, was faciocervical in fifty-four patients, abdominal in sixteen, pulmonary in three and cutaneous in one.

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[9] Musser, J. H.; Pearce, R. M., and Gwyn, N.: Two Cases of Streptothrical Infection: Demonstration of a Streptothrix, or Branched Tubercle Bacillus in the Sputum, Trans. Assn. Am. Phys. **16**:208-216, 1901.

[10] Corinth, Margarete: Ueber einen Fall von Aktinomykose des Ganglion Gasseri, Deutsch. Ztschr. f. Nervenh. **65**:155-168, 1920.

[11] Howard, W. T., Jr.: Actinomycosis of the Central Nervous System, with the Report of a Case Due to an Unidentified Member of the Actinomyces Group, J. Med. Res. **9**:301-323, 1903.

[12] Bollinger, O.: Ueber eine neue Pilzkrankheit beim Rinde, Centralbl. f. d. med. Wchnschr. **34**:789-792, 1887.

Twenty-six patients are known to be living, thirty cannot be traced, and eighteen are dead. Of the twenty-six living, the majority have fully recovered and have been well for from five months to three years. The location of the actinomycosis in the eighteen patients who died with the disease was abdominal in eight, faciocervical in five, pulmonary in three and abdominopulmonary in two.

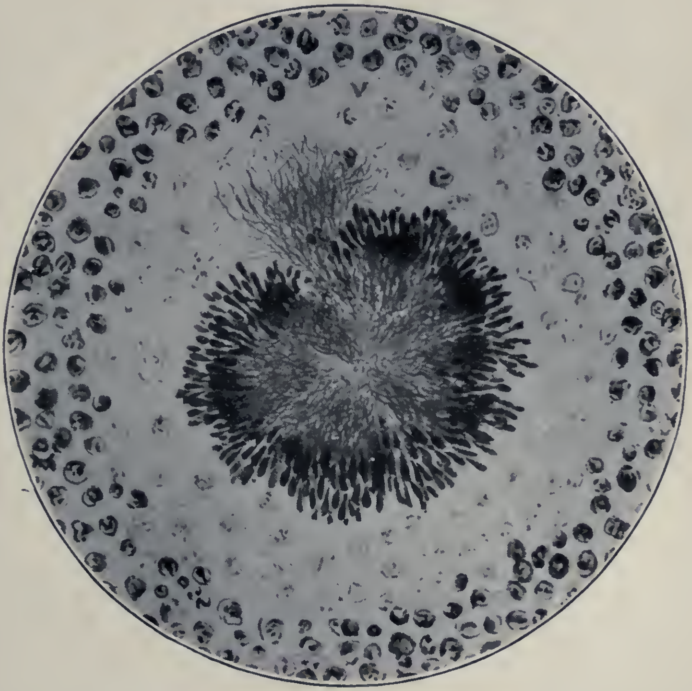

Fig. 1.—Crushed sulphur granule showing ray-fungus, cortical and medullary zones. The cortical zone is made up of club-shaped hyphae; the medullary zone, of filamentous fibers.

There was positive evidence of the involvement of the central nervous system in five of the eighteen patients who died of actinomycosis; the evidence was confirmed by necropsy in two. Two patients with signs of involvement of the central nervous system are alive (Cases 4 and 6 in the table). Two other patients had signs of involvement of the central nervous system, but the subsequent course is not known. These two patients are not included in the series. Undoubtedly other patients in the series of seventy-four had involvement of the central nervous system, but unfortunately the cause of death could not be determined. The two patients who came to necropsy presented fairly typical pictures. The histories are reported herewith.

REPORT OF CASES

Case 1 (A 254829).—A man, aged 41 years, was examined Jan. 3, 1919. His personal history was negative, except for tonsillitis in August, 1918, when he had first noticed increasing difficulty in opening his mouth. He complained of pain in the right temporal region, most severe at night.

Examination revealed ankylosis of the jaw, deafness of the right ear, which came on with the tonsillitis, and an unerupted upper right third molar. The results of the neurologic examination were negative. An indeterminate diagnosis was made, and Jan. 8, 1919, roentgen-ray treatments not having caused any apparent change, the jaw was stretched and the upper third molar extracted.

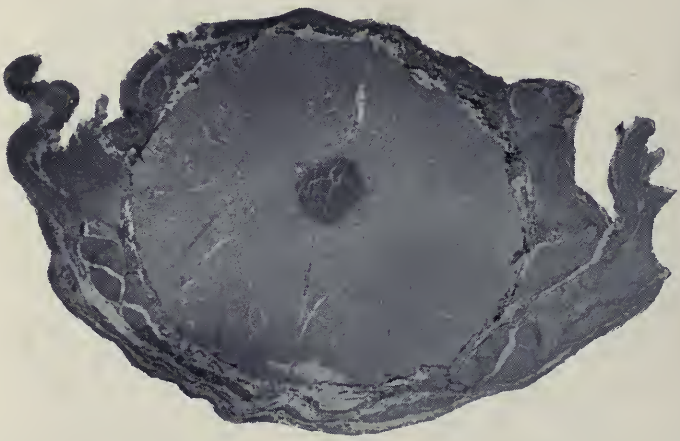

Fig. 2 (Case A 326059).—Section of the spinal cord showing marked meningitis with ependymitis.

The swelling in the region of the right parotid gradually increased, and February 24 a phlegmon over the angle of the jaw was drained. The condition spread and not until one month later, when a phlegmon in the right cervical region was drained and sulphur granules discovered in the pus, was the diagnosis of actinomycosis made.

The patient gradually became weaker, no benefit having been experienced from radium treatment. A second neurologic examination, April 8, revealed paralysis of the right external rectus, nystagmus to the right, hypesthesia and hypalgesia over the right fifth nerve area with weakness of the masseter, temporal and pterygoid muscles. All deep reflexes were exaggerated, the Kernig sign positive and the plantar reflexes flexor. The neck was rigid. The mental state was unimpaired. A diagnosis of low grade meningitis was made. Spinal puncture disclosed a cloudy, thick, purulent fluid; the cells were not counted, but pus cells predominated. No organisms were found and no actinomycetes or sulphur granules. The neck gradually became stiffer; the knee reflexes were difficult to obtain. The right seventh nerve also showed considerable weakness. The patient died April 22, 1919, after being semiconscious for two days.

Necropsy revealed an extensive actinomycetic granuloma of the right parotid region with erosion of the petrous portion of the right temporal bone and basilar and spinal leptomeningitis. The exudate was yellow. A sinus could be traced from the parotid region through the thick portion of the temporal bone into the middle cerebral fossa. Cultures from the spinal fluid gave short chain streptococci but no ray fungi.

Sections were made from various areas of the brain and cervical cord and stained with hemotoxylin-eosin, thionin, Cajal's and Gram's stains. Sections from the vertex showed moderate lymphocytic infiltration of the pia. The cortex showed no marked change; there was no blood vessel infiltration. Gram's stain was negative for this region. The basal portions showed extensive meningeal infiltration, chiefly mononuclear. The process was confined almost entirely to the membranes, the cortical substance remaining relatively free. In the membranes of the right pons a typical ray fungus with marked polymorphonuclear infiltration was found. Gram's stain in every case appeared to be elective, and the growth might have been overlooked if only the usual stains had been employed. Sections of the cord showed similar infiltration of the membranes, predominantly lymphocytic, but no ray fungus.

Case 2 (A 326059).—A man, aged 25 years, a farmer, was examined Sept. 11, 1920. In February, 1920, he had noticed slight drooping of the right eyelid, with ringing and deafness in the right ear. Some time prior to this he had sustained a small cut over the right eye by a whip. Two weeks later burning pain and numbness in the right leg made walking difficult. About June 1, 1920, he began to experience pain in the right frontal and temporal regions, with swelling in the temporal area.

Examination, July 28, revealed swelling of the right temporal region with exophthalmos of the right eye. The patient was somewhat emaciated. There were blurring of both fundi, deafness in the right ear, diminution of sensation over the right supra-orbital region, and slight weakness of the right leg. July 31, pus containing actinomycetes was drained from a small abscess over the right upper lid. The spinal fluid report was: positive Nonne reaction; 1,889 polymorphonuclear leukocytes, 587 small lymphocytes, and Lange's test 0 1 1 1 2 2 1 0 0 0. Because of the headache and blurring disks a decompression operation was performed August 10. The findings were negative.

The patient was dismissed from observation and returned September, 1920. when the spinal fluid showed 841 polymorphonuclears, 128 lymphocytes and no granules; his temperature was 100 F.; he had no clinical signs of meningitis. He gradually became worse; emaciation was marked; he passed into a mild state of confusion with muttering delirium.

September 26, the patellar and Achilles reflexes could not be obtained; there was no Babinski sign and only moderate rigidity of the neck. Until the day of death no paralysis occurred, although the right leg was weak. At times headache was very severe. The patient died Sept. 28, 1920.

Necropsy revealed the scar of operation, but no infection or growth. The membranes were adherent at the right orbital ridge, and a thick layer of gelatinous, greenish-yellow pus surrounded the area and covered the entire basal surface. Throughout the pus numerous pin-point granules could be seen. The point of infection was apparently at the orbital ridge, where a spot the size of a pencil head could be distinguished and from which a sinus led directly into the orbital space where the pus was very thick and tenacious. The entire cord was bathed in thick, greenish yellow pus, most marked in the caudal region.

Actinomycosis of the Central Nervous System—Seven Cases

Case	Sex Age	Occupation	Primary Focus	Duration of Symptoms, Months	Neurologic Signs of Central Nervous System Involvement	Headache	Temperature	Mental Symptoms	Lymphocytes	Spinal Fluid	Diagnosis	Remarks
130341	M 34	Farmer	Chest	18	General weakness, tremor and increased reflexes; repeated convulsive attacks	Moderate	99?	Terminal mental apathy	11,000 16,000	Negative	Actinomycosis, probably abscess	Patient died at home; no necropsy
254829	M 41	Farmer	Jaw	9	Cranial nerve palsy, choked disks, increased deep reflexes, rigid neck and positive Kernig's sign	Moderate	99 100	Terminal unconsciousness	6,800 15,000	Purulent	Actinomycosis meningitis	Necropsy showed meningitis of both brain and cord
320695	M 38	Farmer	Jaw	8	Cranial nerve palsy, rigid neck and paresthesias	Severe, localized in left frontal to parietal area	Moderate	Mild delirium	9,000 11,800	Nonne +; polymorphonuclears 1,735. lymphocytes 170	Actinomycosis meningitis	Patient died at home; no necropsy
325362	M 20	Farmer	Jaw	?	Proptosis, cranial nerve palsy, rigid, neck, no clinical signs of meningitis	Moderate	....	....	6,800	Negative	Probably actinomycosis meningitis	Patient alive
326059	M 25	Farmer	Jaw	8	Cranial nerve palsy, headache, rigid neck, delirium, and numbness in limbs	Severe, localized in temporal area	98 100	Mild delirium	6,900	Nonne +, Lange 0111221000, polymorphonuclears 1,889, lymphocytes 587	Actinomycosis meningitis	Necropsy showed meningitis of both brain and cord
347777	M 24	Farmer	Jaw	7	Cranial nerve palsy, rigid neck, mental torpor	Moderate	99 100	Mild grade delirium	12,000	Negative	Actinomycosis meningitis	Patient died, no necropsy
371666	F 27	Housewife	Jaw	6	Motor and sensory involvement of right fifth nerve and headache; no clinical signs of meningitis	Moderate	99 101	....	11,000	Wassermann +, Nonne +, polymorphonuclears 92, lymphocytes 400	Actinomycosis meningitis	Patient alive

Sections were taken from the brain and cord and stained with hematoxylin-eosin, thionin, Cajal's, Weigert's, and Gram's stains. As in Case 1, the convolutions showed only slight involvement. Sections from the base and especially those taken at the cerebellopontile angle showed severe meningeal infiltration and some polymorphonuclear cells. The reaction was confined chiefly to the membranes in which the fungus was present, although the brain substance showed some cell degeneration and slight blood vessel infiltration.

Sections from the cord showed severe meningitis, with many polymorphonuclear cells. The central canal throughout was filled with polymorphonuclear cells; the exact cause of their occurrence remains uncertain (Fig. 2). The cord substance showed some swelling of the nerve cells with displaced nuclei and moderate blood vessel infiltration, but no abscesses or foci were discovered and no fungi were found in the membranes of the cord.

What has been said of actinomycosis apparently holds true for many other mycotic affections. Ophüls,[13] in 1905, reported thirteen cases of coccidioidal granuloma, three of which showed central nervous system involvement. Rusk and Farnell[14] reported several cases of oidiomycosis with meningitis. Since the work of Gilchrist,[15] over twenty cases of blastomycosis with involvement of the nervous system have been reported. Bassoe,[16] in 1906, first reported a case of blastomycosis with cerebral involvement. Montgomery,[17] in 1917, in a review of blastomycotic infections reported eight cases with brain abscess and several others with involvement of the cord and meninges.

CONCLUSIONS

Actinomycotic involvement of the central nervous system is not rare. The disease process is usually secondary to some other focus in the body, and apparently the meningeal type, in which the infection takes place by contiguity, is most frequent. The course of the disease is chronic, with markedly insidious onset, meningeal involvement occurring without any clinical signs or symptoms. There is some evidence that involvement of the meninges occurs long before the spinal fluid shows evidence of trouble, but the serologic examination usually shows

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13. Ophüls, W.: Coccidioidal Granuloma, J. A. M. A. **45**:1291-1296 (Oct. 28) 1905.

14. Rusk, G. Y., and Farnell, F. J.: Systemic Oidiomycosis; a Study of Two Cases Developing Terminal Oidiomycetic Meningitis, with Clinical Notes, Univ. Calif. Pub. Path. **2**:47-58, 1912.

15. Gilchrist, T. C.: A Case of Blastomycetic Dermatitis in Man, Johns Hopkins Hosp. Rep. **1**:269-289, 1896.

16. Bassoe, P.: Disseminated Blastomycosis. Report of a Case Involving the Lungs, Lumbar Vertebrae and Subcutaneous Tissues, with Multiple Abscesses and Fistulae, and Extensive Amyloid Degeneration, J. Infect. Dis. **3**:91-101, 1906.

17. Montgomery, A. H.: Blastomycosis and Sporotrichosis, Surg. Clin. of Chicago **1**:1125-1138, 1917.

a pleocytosis long before there is any clinical evidence of meningitis. It has been suggested that clinical signs of meningitis develop only after secondary infection has occurred. The positive spinal fluid with only slight signs of meningitis is almost pathognomonic. In no other form of severe meningitis do we see such a lack of clinical findings. The ability of these patients to be up and about, presenting few complaints, such as moderate headache, slight rigidity of the neck, and only slight temperature, is practically unknown among other forms of meningitis. During the terminal stage of actinomycosis, the diagnosis is certain, but in the early stages a positive diagnosis on clinical findings alone is practically impossible.

The presence of a chronic phlegmon of the head or neck should indicate the possibility of actinomycosis, and an examination of the spinal fluid and a search for sulphur granules should be made.

The course of the disease is characterized by low grade fever, rarely more than 101 F. and not of the usual septic type, headaches, common and chronic but not unusually severe, terminal delirium, and profound emaciation.

The importance of an early diagnosis in actinomycosis is paramount because of the prognosis. Involvement of the nervous system makes prognosis hopeless. Potassium iodid, arsphenamin and other remedies have been tried, but with uniform failure.

Abstracts from Current Literature

CONTRIBUTION TO THE DOCTRINE OF SENSIBILITY. H. **Doebeli**, Schweiz. Arch. f. Neurol. u. Psychiat. **9**:75-90, 1921.

Doebeli believes that there is still a large field for the study of sensibility, particularly as it applies to the investigation of disturbances of sensibility that do not reach the field of consciousness. Certainly the largest and physiologically the most interesting group of centripetal impulses do not reach consciousness or are interpreted in a greatly altered manner. A classification of the various known types of sensibility is given, after which Doebeli proceeds at once to his problem: Are there other than the already known forms of irritation capable of exciting the sensory functions of the human organism, such as the ultraviolet rays, the roentgen rays, etc.? He asks the following questions:

1. Is there cutaneous sensibility for moisture? There is no question that rheumatic persons can often foretell with marked precision some change in the weather. When we consider how often moisture is used as a form of therapy, the practical side of this question becomes apparent. Tambroni is the only writer who postulates a so-called "sensibilita igrica," which he went so far as to localize in the brain. His entire doctrine was based on a single case of dementia paralytica. This patient asserted that he could tell when there was moisture in the bed regardless of whether this was obvious or not. On examination of the brain some changes were found in the gyrus hippocampus, from which he assumed that the center of this form of sensibility must be located in this region. He was, as a matter of fact, dealing with illusions and delusions. The marked sensitiveness of the mucous membranes of the mouth, nose and throat to moisture is well known. We are confronted with the question as to whether there is such a form of sensibility present over the cutaneous surface of the body. If so, can any conclusions be drawn relative to the location of these organs of special sensibility?

2. As regards the sensation of itching there is a considerable difference of opinion. For example, Winkler states that itching results from an irritation of Merkel's tactile corpuscles; Thoele, that it is due to a slight irritation of pain fibers; Samberger, that it is the function of specialized organs located among the epithelial cells, particularly in the sheath lying about hair roots. If it is a partial expression of irritation of the organs carrying the sensibility of pain, it should not be present in the analgesic area of certain lesions of the nervous system, such as the lesions of syringomyelia.

3. Is pain elicited on deep pressure over an area of cutaneous analgesia in a case of syringomyelia? In other words, do the tracts carrying cutaneous sensibility and pressure pain sensibility occupy the same position in the cord?

4. One of the forms of deep sensibility is that of joint tenderness. Exactly where arthritic pains arise has not been studied so far as the writer is aware. Does this pain come from the capsule of the joint, from the ligaments, the serous surface, the cartilage, the periosteum, the tendon attachments, or the neighboring muscles; does it arise through pressure, traction or chemical irritation? This type of pain is quite characteristic and can be produced by sub-

luxation of the joint. To what extent is this form of sensibility disturbed in a case of syringomyelia in which cutaneous and deep sensibilities are otherwise interfered with?

5. Where do the receptors lie that subserve the function of so-called position of joint sensibility? Is it a part of deep sensibility as has heretofore been generally accepted, or is it related to cutaneous sensibility, as von Frey and his followers believe?

6. Another form of sensibility which has not been fully investigated is that accompanying local anemia of the tissues, such as can be produced by an Esmarch bandage. This might be called the sensation of blood hunger. Where are the tracts that carry this pain toward the central nervous system? Do they pass through the spinal ganglions and the commissura anterior, similar to impulses of pain, or do they belong to the afferent sympathetic system? This question also applies to the sensation experienced when the blood returns to such an extremity.

7. A contribution of H. Brunschweiler for the first time emphasizes the so-called directional sensibility of the skin and its disturbance in lesions of the parietal region. This directional sensibility can be tested through a light stroking of the fingers over the skin. The question is one of the associations-valence of cutaneous sensibility with the conception of space. In other words, is directional sensibility disturbed over the area of impaired cutaneous sensibility commonly observed in syringomyelia?

8. It has been definitely established that the psychogalvanic phenomenon objectively differentiates hysterical from organic causes of an area of anesthesia. Which afferent tracts produce changes in the skin in the neighborhood of the electrodes in these cases is not known. This subject can be studied to some degree in syringomyelia.

The foregoing problems have been answered through a study of three cases of syringomyelobulbelia.

Case 1.—The patient was one of twins. While going to school the hands were often cold and blue, and the patient had burned himself many times. At about 32 years of age a phlegmon appeared on the right hand, which was followed by progressive weakness in the arms, stiffness of the legs, kyphoscoliosis, atrophy of the shoulder girdle muscles, nystagmus, hemiatrophy of the tongue, syringomyelic paws, and disturbances of touch, pain and temperature sensibility. With the exception of the area supplied by the fifth nerve, pain and temperature were lost to the level of the iliac crests. Tactile and localization sensibility were preserved everywhere with the exception of a small area near the scapula.

Case 2.—The patient was a woman, 39 years of age. At the age of 28, she had painless burns about the right shoulder. At 34 years of age, she had cramps in the right arm and leg and weakness of both arms, nystagmus, atrophy of the shoulder-girdle muscles, fibrillary tremors of the thenar eminence, right pes equinus, increased tendon reflexes, a positive Romberg sign, and the sweat glands ceased functioning. Pain and temperature sense were lost symmetrically below both areas supplied by the fifth to the level of the breasts and the seventh dorsal spine. Tactile and localization sensibilities were normal throughout.

Case 3.—A young woman, aged 25, had scarlet fever with rigidity of the neck at 12 years of age. At 17 years of age, there was a sudden onset of painful cramps; since that time there had been deafness of the right ear, diplopia and limping. At 22 years of age, she had dyspnea, hoarseness, dysphasia, emaciation, nystagmus, reduced sensibility of the tympanic membrane, paralysis of the soft palate, fibrillary tremors of the pharynx, posticus paralysis, some atrophy of the shoulder girdle muscles, Morvan's syndrome of the right hand and increased tendon reflexes on the left. There was loss of pain and temperature sensibilities below the fifth, with the exception of the left leg and the neighboring saddle area. Tactile sensibility everywhere was normal with the exception of an irregular area over the right shoulder. Pain and temperature sensibility over the right leg was better toward the periphery, but not entirely normal.

Moisture sensibility was investigated in the following manner: Moist or dry air was conducted through a piece of tubing into one end of a box, about the size and shape of the ordinary cigar box. Across the middle of the box was a perforated partition, the purpose of which was to distribute the introduced air more equally. The end of the box opposite the tube was replaced by a batton padding, which permitted close application to the body surface. Near the padding was a hole for the introduction of a thermometer. A hygrometer was suspended in the box near the same end. In carrying out the test, the padded end was placed firmly against the area of skin to be investigated. Dry or moist air was introduced as desired, and the temperature, moisture content and duration of application recorded. The experiment was carefully checked so that all associated factors, such as noise from the source of air supply, could be eliminated. The moisture content in these experiments ranged from 34 to 100 per cent., the temperature from 35 to 54 C., and the duration from ten seconds to seventeen minutes. The subjects were five normal persons, aged 22 to 35 years, one of them an experienced hydrotherapist, a patient with sciatica, 44 years of age, one with muscular rheumatism, 30 years of age, a patient with arthritis, 62 years of age, another with arthritis deformans, 40 years of age, one with rheumatic lumbago, 38 years of age, and one with syringomyelia, 30 years of age.

The result of these experiments was the observation that different degrees of moisture cannot be differentiated when applied to the skin, regardless of the temperature or the duration of application. There was a limited ability to do this over the chest area, provided this was heavily covered with hair; this may be dependent on the hygroscopic qualities of hair.

There was no heightened sensibility in patients with rheumatism or arthritis.

The mucous membranes of the mouth and nose are very sensitive to changes in moisture, and it is possible that our appreciation of moisture in the surrounding atmosphere is elicited through this medium.

The article is to be continued.

Woltman, Rochester, Minn.

A SPECIAL TYPE OF GALVANIC HYPERIRRITABILITY OCCURRING IN "FRAGILITAS OSSIUM." G. C. Bolton, Monatschr. f. Psychiat. u. Neurol. **49**: 144 (March) 1921.

The association of bluish discoloration of the sclerae and abnormal fragility of the skeletal bones, has been repeatedly noted. Burrows states that in fragilitas ossium the sclerae are always blue, but that conversely, blue sclerae may occur independently of abnormal bone fragility. These points have been confirmed by the author's material.

The author reports four new cases of fragilitas ossium, all having certain well defined features: abnormal fragility of the bones; blue sclerae; calcium deficiency in the long bones; vasomotortrophic disturbances, such as acrocyanosis, chilblains, brittle spotted nails, enamel defects, deficient hair, falling hair, urticaria, migraine, angioneurotic edema, etc.; a special type of galvanic hyperirritability.

The existence of galvanic hyperirritability deserves special note, both because it has not been previously reported in the literature, and because it gives a clue to the genesis of the entire syndrome. Since the studies of Erb we have become familiar with galvanic hyperirritability in tetany. In tetany we find a general lowering of minimal values for all phases of the contraction formula.

In fragilitas ossium, the author found a galvanic hyperirritability of somewhat different type. Values for the closing contractions were little (in some cases not at all) reduced, whereas the values for the opening contractions were always much below normal—never over 3.2 milliamperes. The most marked lowering occurred in the cathode opening contraction (2.8-3.2 milliamperes in this series as against a normal of 6-7 milliamperes). The character of the contraction was normal throughout.

Author's Table

	Case 1 Ma.	Case 2 Ma.	Case 3 Ma.	Case 4 Ma.	Normal Ma.
CCC	1.2	1.0	0.8	0.8	0.8-1.5
ACC	2.0	2.0	2.2	2.4	2.5-3.0
AOC	3.0	2.4	2.8	3.0	3.0-3.5
COC	2.2	2.8	3.0	3.0	6.0-7.0

A galvanic hyperirritability of similar type has been described by Klose and Vogt in puppies following thymus extirpation. The following table records the type of their findings:

Median Nerve	CCC Ma.	ACC Ma.	AOC Ma.	COC Ma.
8-day old puppy	1.8	2.0	4.2	6.3
Same puppy ten days after thymectomy	1.5	1.5	2.5	2.8

The striking similarity between the galvanic values in his four cases and in thymectomized puppies suggests to the author that in fragilitas ossium, thymus insufficiency plays an important rôle. This seems logical enough. Bone growth is governed largely by three organs: the thyroid, parathyroid and thymus glands. In the author's cases there was little evidence of thyroid insufficiency. The type of bone disturbance, as shown by the roentgen ray, was largely a calcium deficiency. Both the parathyroid and thymus glands play an important rôle in bone calcification. In the cachexia which follows thymectomy, Klose and Vogt find as constant features certain definite bony changes: marked growth inhibition, softness, pliability and even fragility of the skeletal bones; the long bones are brittle and easily broken; spontaneous fractures are common. This indicates that following thymectomy, calcium metabolism is grossly disturbed. Microscopically the calcification zone of the original cartilage is smaller than normal. These changes, which produce a picture of bone atrophy, are, according to Klose and Vogt, the expression of a specific thymectogenic bone disease, and depends on a lack of undissolved calcium, which in experimental animals following thymectomy may be reduced to half the normal.

The author believes that in his four cases we are justified in assuming the existence of a trophoneurosis, that is, a group of metabolic disturbances due to insufficiency of thymus and parathyroids, along with a slight hypothyroidism. This glandular insufficiency rests probably on a hereditary basis. As a necessary result of the diminished function of these sympathicotonic glands, a slight vasomotor insufficiency results.

In Summary: The fragility of the skeletal bones, the blue color of the sclerae, the calcium poverty of the bones, the vasomotor trophic disturbances and the galvanic hyperirritability may be considered as genetically equivalent, or at least closely related. They are all subheads of a trophoneurosis, in which disturbances in calcium metabolism play an important rôle, and which rest on a thymus and parathyroid (perhaps also a slight thyroid) insufficiency.

In view of the infrequency of the condition, one of the case reports is appended.

I. B., a girl, aged 15, whose family history was negative, and who had no neuropathic heredity, had always been nervous. She had had rachitis as a child. Her skeletal bones were abnormally breakable. She broke one leg sixteen times, fifteen times following a slight fall on level ground. Formerly she had gastro-intestinal disturbances, such as gastric pain with vomiting, anorexia and apparently "urticaria interna"; periodic attacks of severe abdominal pain with distention and, for a day or two, diarrhea; this would be repeated after six or eight weeks, independent of errors of diet or of constipation. She had vasomotor trophic phenomena; she frequently suffered from cold hands and feet; in winter she always had chilblains on her hands and feet; her nails were brittle, broke easily and were spotted; her teeth were very bad with a large amount of caries; her upper lateral incisors were much too small; there were some enamel defects; her hair was thin and had a tendency to fall out; cataract was not present. She had paresthesias in the feet (not in the hands) during the winter and often complained of dead fingers (local syncope); sometimes her skin itched. She often had headache, and formerly had hyperacidity and nausea. Her sclerae showed a fairly distinct blue discoloration. The Chvostek phenomenon was present in slight degree. Her pulse was regular and equal with a rate from 82 to 90; her blood pressure was a little low. Blood count revealed, eosinophilia, 6 per cent.; polymorphonuclears, 35 per cent.; large mononuclears, 3 per cent.; lymphocytes, 55 per cent., and transitionals, 1 per cent. The Aschner and Tshermak phenomena were negative. Moderate dermatographia was present. The temperature was normal. Galvanic values for the facial: cathodal closing contraction, 1.5 ma.; anodal closing contraction, 2 ma.; anodal opening contraction, 3 ma.; cathodal opening contraction, 3.2 ma. tion, 3.2 ma.

Selling, Portland, Ore.

BRADYKINETIC ANALYSIS OF SOMATIC MOTOR DISTURBANCES.

S. Philip Goodhart and Frederick Tilney, Neurol Bull. **3**: No. 9-10 (Sept.-Oct.) 1921.

In this paper the authors give the results of their study of abnormal involuntary movements by means of ultra-rapid moving pictures. They employed the Novograph camera which takes pictures at the rate of 160 to 300 exposures a second (the ordinary cinematographic rate is sixteen a second). The normal rate of projection on the screen of the rapid moving pictures slows down the movements to such an extent that it permits analysis of every component. This method the authors call bradykinetic analysis.

Although employing the various terms now commonly used to designate the types of abnormal movements, the authors feel that they are inadequate and would therefore substitute descriptive terms. They offer the following objective analysis of adventitious motor elements which can be observed in various conditions:

1. Regular rhythmical oscillations of parts of the body during muscular inactivity or in volitional action.
2. Irregular arrhythmical oscillations of parts of the body during volitional motion.
3. Sudden isolated twitches of the muscles producing involuntary movements or deflecting the course of volitional motion.
4. Sudden successive twitches of muscles producing involuntary movements or deflecting the course of volitional motion.
5. Sustained mobile spasms of muscles during volitional motion producing rhythmical distortions of the limb, trunk or limited parts of the body during activity of the particular part.
6. Sustained tonic spasms of limited groups of muscles during volitional motion which retard or deform the resulting movements.
7. Sustained tonic spasm in a large number of muscle groups during activity or in rest, producing distortion of the body together with marked deformity of motion during action.

The first case studied was one of chronic degenerative chorea in a woman. The normal rate of projection showed irregular, meaningless, purposeless movements. Bradykinetic analysis showed that these movements apparently had a definite associative significance. They comprised a series of symbolic attitudes indicative of emotion and expressing entreaty, or a negative self-feeling of shame. These associated movements and emotional expressions would link the disease with the corpus striatum and optic thalamus and also point to the subconscious controlling level in hysteria. The analysis also brought out the failure of the kinetic mechanism controlling associated movements and impairment of the static mechanism.

The second case was one of chronic degenerative chorea in a man, with some elements of dystonia. Here analysis also brought out attitudinizing, but of the positive feeling tone characteristic of the male. There were, besides the choreic movements, sustained tonic spasms producing distortions which are manifestations of hyperkinetic innervation of muscles recognized as the essential part of the syndrome of dystonia.

Analysis of the third case, which was one of multiple sclerosis, showed a disintegration of the synergic units throughout the body, an incoordination between agonists and antagonists, a failure in the check elements of the opposing groups of muscles. The tremor was shown to be the result of a static defect, due to the dissociation of the synergic units of the body, consequent on the disproportionate innervation of the dominant and check elements in the muscle groups. This proves that the "tremor" is cerebellar in origin.

Case 4 was diagnosticated clinically as a functional astasia abasia with excessive isolated and successive spasms of the muscles of locomotion. Analysis showed that these movements were expressive of acutely conscious and psychically much magnified fear, in contrast with the simpler attitudinizing of chorea. A wavelike contraction in the muscles, possibly significant of functional dyskinesis, was also observed.

Study of three cases of dystonia musculorum deformans in a brother and two sisters revealed disturbances of movement due to a partial failure of coordinate time reaction in groups of agonists and antagonists. There was excessive innervation of both the kinetic and static elements of motion with the resultant extreme degree of movement and posture, in many instances amounting to actual distortions. This marked overflow of innervation was apparent in nearly every group of muscles in the body, producing needless and often untimely postures as well as active movements wholly unnecessary to the acts performed.

Analysis of another case of dystonia with extreme sustained spasms again showed an unchecked overflow of kinetic energy and a static dissociation which threw the patient into involuntary attitudes. Study of two other cases of dystonia, one with sudden ticlike movements, "dromedary attitude" and semilunar foot, further demonstrated the disorganization between the static and kinetic mechanisms. All patients with dystonia showed the imbalance in the ratio of the two kinds of energy, especially during volitional effort. The disturbance in the rhythm of the two mechanisms, due to improper synchronization in time, force and rate of action, leads to a conflict between the hyperstatic and hyperkinetic innervation.

The last case to be analyzed was one of cerebellar ataxia due to cerebellar aplasia. The ataxia or asynergia was shown to be due to failure of proper coordination in the synergic units of the body and to disproportionate innervation of the dominant and check elements of the individual units.

The authors came to these conclusions:

1. Bradykinetic analysis permits minute study of disturbances of motion.
2. Adventitious elements in motor disturbances are manifest as disorders of the kinetic or static mechanism.
3. All purposive movements depend on the concurrent and synchronized operation of the kinetic and static mechanisms. Such movements are made up of a series of postures.
4. The kinetic mechanism is represented by a neural mechanism capable of correlating the impulses necessary to the production of purposive movements, attitudes and postures.
5. The static mechanism is represented by a neural mechanism capable of correlating the impulses necessary to the maintenance of postures.
6. Present evidence warrants the allocation of the chief center of the static area in the cerebellum and the kinetic in the end brain, with the primordial center of the second in the striatum.
7. The disorders of motion investigated may be attributed to disorganization in the two fundamental neural areas.
8. Choreiform movements of degenerative chorea are due to a hyperkinetic disorder resulting in the sudden production of postures and attitudes expressive of emotions. In astasia abasia the movements the emotions express are of a more complex kind, indicative of psychic elaboration.
9. Cerebellar ataxia and intention tremor are due to the same defect of the static mechanism-disorganization of the synergic units.
10. Dystonias are both hyperstatic and hyperkinetic in nature, with the absence of normal concurrence between the two streams of innervation. These mechanisms appear to be affected by pronounced irritation or lack of proper inhibition.

Wechsler, New York.

EXPERIMENTS ON THE TRANSPLANTATION OF LIMBS IN AMBLYSTOMA. FURTHER OBSERVATIONS ON PERIPHERAL NERVE CONNECTIONS. S. R. Detwiler, J. Exper. Zoology **35:**115, 1922.

Shifting the position of the fore-limb rudiment of Amblystoma embryos in the tail bud state a given number of body segments anterior or posterior to its normal site does not effect to the same extent a corresponding shifting of the segmental nerve contribution to the brachial plexus. There is a marked tendency for transplanted limbs to receive innervation from the normal limb level of the cord. The number of segments occupied by a transplanted limb does not determine the number of the segmental nerves contributing to its plexus. When the fore-limb rudiment is transplanted from two to three segments anterior to the normal position, the distal portions of the normal limb nerves are found to grow anteriorly to the distance of several segments to effect functional connection with the heterotopic appendage. The proximal portions of the nerve follow a normal pathway. In effecting connections with the limb, the nerves apparently grow anteriorly against the mechanical opposition of the developing myotomes, which tends to direct them caudally.

The results of the present limb experiments strongly suggest that there exists between the limb and its normal nerves a developmental relationship which is more intimate in character than any developmental association between these same nerves and other structures. The contention is thus supported that mechanical influences, although governing in large measure the character of nerve pathways, do not reveal the mechanism by which proper connections are made at the periphery. It is probable that there exists at the periphery forces of a chemotactic or galvanotactic nature which bring about orderly selectivity.

The function of transplanted limbs is conditioned by four main factors: (1) structural incompleteness of the shoulder girdle, (2) defective development of the limb and the shoulder muscles, (3) defective peripheral innervation, and (4) defective connections within the central nervous system. The gradual loss of function in limbs as they are transplanted farther and farther away from the normal situation is attributed to increased defective connections with the central reflex pathways involved in normal limb locomotion, or rather to a corresponding decrease in effective peripheral innervation and structural deficiency of the shoulder and limb. The high percentage of abnormalities in limbs transplanted from two to three segments anterior to the normal position is due to the fact that they are placed in the environment of active gill-forming tissue. In these cases the gill-producing properties of the tissue surrounding the transplant markedly disturb the normal posture and differentiation of the appendage. When the ectoderm and mesoderm are removed from the entire external gill swelling and a limb is transplanted into the denuded area, abortive gills may develop from the surrounding tissue. The results of the experiments indicate that the tissue lying ventral to the typical gill region possesses a relatively higher gill-forming capacity than does that lying anterior or dorsal. That the outgrowth factors for the external gills reside not only in the ectoderm of the immediate gill region, but extend with diminishing degree of intensity into the surrounding ectoderm, is evident. The hypoglossal nerve in Amblystoma is formed by the union of the ventral rami of the first and second spinal nerves and corresponds with the arrangement characteristic for urodeles. The entire ventral ramus of the second spinal nerve may contribute nerves to the transplanted limb. In such cases the hypobranchial musculature is supplied by the first spinal nerve. When the ventral portion of the first myotome is excised with the gill mass, the anterior segments of the sternohyoid muscle, the geniohyoid muscle and the hypoglossus muscle are absent on the operated side. The hypoglossal trunk in such cases does not assume its normal anterior pathway, but terminates in the posterior segments of the sternohyoid muscle.

Wyman, Cambridge, Mass.

DISTURBANCES IN RELATION TO COLORS IN APHASIC PATIENTS.

Otto Sittig, Monatschr. f. Psychiat. u. Neurol. **49**:63 (Feb.) 1921, and **49**:159 (March) 1921.

Color blindness may be congenital or acquired. The acquired type may be peripheral or central in origin. The brain pathologist is chiefly interested in acquired color blindness of cerebral origin.

In 1884, Wilbrand described a group of cases in which the patient is able to recognize and distinguish all colors but is unable to associate the color with its appropriate name; that is, he misnames colors which are shown him; if a color is named, he cannot pick it out of a group; and he is unable to name the color of familiar objects. This disturbance though bearing a superficial resemblance to color blindness, is in reality an aphasia. Wilbrand called it amnestic color blindness.

Patients' Behavior Toward Colors

Case	Sorting of Colors	Naming of Colors	Understanding of Names of Colors	From Memory: Colors of Objects		Color Shown, Name an Object of This Color	Appreciation of Falsely Colored Pictures
				Naming	Showing		
1	Disturbed	Disturbed	Disturbed	Disturbed	Disturbed	Disturbed	Usually good
2	Disturbed	Disturbed	Disturbed	Good	Disturbed	Disturbed	Good
3	Disturbed	Disturbed	Disturbed	Disturbed	Partly disturbed	Disturbed	

The author describes three cases:

Case 1: Gunshot wound of the left occipital region, with injury to the underlying brain tissue. The patient showed the remains of a temporal lobe aphasia, with difficulty of word finding as the outstanding feature.

Case 2: Thrombotic softening on an arteriosclerotic basis. Clinically this patient showed a pure alexia and a word amnesia.

Case 3: Tumor which had led to temporal lobe aphasia with marked disturbance of word finding.

The chief interest in these cases centers in the behavior of the patients toward colors. An analysis of this behavior is found in the table.

In all three cases accurate tests showed that color perception itself was normal. Referring to the table, we find that the three cases have certain things in common. The patient cannot correctly name colors; he has lost understanding of the names of colors. If an object is named to him (lemon, cherry) he is unable to name the color of that object. In explanation of these phenomena we are justified in assuming a pure aphasia for names of colors—"Farbennamenamnesie," in Wilbrand's sense. But this is not the whole story; when an object is named to the patient, the color of that object cannot be picked out of a group of colors. There have been several attempts to explain this. On purely theoretical grounds, there are three possibilities.

1. Disturbance of recognition (Erkennen). Color perception per se is normal, as demonstrated by appropriate tests. But this does not mean that color recognition is normal. We know in other fields that perception may be intact, and yet recognition be faulty, due to disturbance of the higher psychic functions. Such disturbances are classified as agnosias. The author calls attention to a possible analogy to mind blindness, and considers the possibility of a classification of this disturbance as a mind-color-blindness. Positive proof of this is difficult.

A second possibility of which much has been made is a disturbance of color memory. Lewandowsky supported this view; others have opposed it.

The third possibility is to consider this inability to pick out of a group of colors the color of an object named an integral part of the aphasic disturbance. Unquestionably the knowledge of the names of colors has some influence on color recognition; but the author is convinced that this alone is insufficient, and that other factors must be sought.

Still more difficult to explain is the disturbance in sorting the Holmgren test colors. This was striking in all of the author's cases, and at first suggested a color blindness of perceptual origin. But careful tests with the Helmholtz color mixing apparatus showed that color perception per se was normal. In analyzing this, the author points out that the Holmgren test is not simply a matter of matching colors. If one changed the Holmgren test about and asked the patient simply to give the exact match for the test color, it worked very well. It was only when all the shades of a given color were to be grouped that difficulties arose. Evidently the trouble lay in abstracting the shade, and bringing the different individual perceptions into a higher concept. Here we are dealing with higher psychic processes of abstraction, attention, evocation of the color concept and grouping of essentials in addition to simple perception.

Summing up the various features of his cases, as shown in the table, the author concludes that the sum total of the phenomena are dependent on the one hand on aphasic disturbances (inability to name colors, etc.) and on the other hand on disturbances of the higher psychic functions (failure to pick from a group, the color of an object named; failure to sort the Holmgren test colors). He calls attention to certain analogies to the explanation of alexia as given by Kramer, and von Stauffenberg. Kramer considers alexia as a summation of slight optic disturbances, plus slight speech disturbances. Von Stauffenberg speaks of alexia as a combination of optic agnosia and speech disturbance. In considering the various color phenomena which his patients have presented the author feels that here, as in alexia, the best explanation is to be found in a summation of speech disturbances and optic agnosia. It is noteworthy that in all the cases of the group either mind-blindness, or alexia, or aphasic troubles (especially amnestic aphasia) were found.

As to the localization of the process, the phenomena described occur in lesions of the posterior portions of the brain, especially in the parieto-occipital lobes.

Summary: 1. We must differentiate between true color blindness and disturbances in relation to colors in which color perception is intact.

2. The latter are characterized by the inability of the patient to name colors correctly, or to understand the names of colors. This is an aphasic disturbance and may be called amnesia for names of colors (Farbennamenamnesie).

3. There are cases in which in addition, color sorting is disturbed. Here the assumption of an aphasia alone is not sufficient. We must assume agnostic disturbances also.

4. These disturbances are often associated with alexia or mind blindness or amnestic aphasia.

5. One hemisphere (usually the left) is dominant.

6. This disturbance in relation to color is complicated and built up of several component parts, which influence each other in such a way that separation of the individual factors is difficult. Analogous to Kramer's and von Stauffenberg's explanation, it is a summation of aphasic and optic-agnostic factors. In some cases the aphasic, in others the agnostic factors predominate. The agnostic factors are to be considered as disturbances of the higher psychic functions as attention, evocation of concept, etc.

7. Owing to the complexity of the phenomena, much further work is required.

8. On anatomic and clinical grounds, one may assume that the lesion is in the parieto-occipital zone.

Selling, Portland, Ore.

DEMENTIA PRAECOX AND THE ADOLESCENT PSYCHOSES FROM THE ORGANIC VISCERAL VIEWPOINT AS REGARDS PROGNOSES AND THERAPY. Daniel J. McCarthy, Am. J. Psychiat. **1**: No. 3 (Jan.) 1922.

McCarthy presents an interesting diagnostic-therapeutic discussion of the adolescent psychoses. They are not synonymous with dementia praecox, and although the reaction is often schizophrenic, one must regard them merely as borderline psychoses. Whether or not they would have progressed to classical syndromes cannot be determined as the great majority are readjusted by appropriate therapeutic endeavors. The nondegenerative group may be sub-divided into: "(*a*) Those whose toxic factors were dependent on pulmonary disease, at the first development period, leading to constitutional and endocrine disturbances at the adolescent period. (*b*) The syphilitic group when early acquired, or inherited syphilis produces a similar reaction as in (*a*). (*c*) Steadily progressive infections in the early adolescent period, belonging in a general way to the focal infections, and leading to reactionary states in the endocrine field. (*d*) Nondetermined infections with thyroidal disturbances. (*e*) Stress reactions in the moron groups, due either to infections or overload leading to a praecox syndrome."

The author believes that many dementia praecox symptoms may be found in embryo in normal adolescence and that a psychologic balance is attained without outside assistance. There is a definite pathologic group that may be classified into: "(*a*) Those whose symptoms are referable to introspection concerning some personal physical characteristic. (*b*) Those in whom problems of a neurosexual nature are the disturbing factors. (*c*) External problems in relation to family affairs leading to a feeling of instability in reference to life and other matters. (*d*) Visceral disease, with an attempt at adjustment for insufficiency, either in purely social matters, at school or in business affairs." The percentage of cases in these groups developing into serious problems depends essentially on the intensity and effect of fundamental instability and continuing intoxication. If there is no or only a slight degree of instability the intoxication must be extremely severe, or if there is gross lack of fundamental equilibrium, the toxic factor may be mild in degree and yet produce a deleterious mental result.

McCarthy's prognostic optimism springs from his aggressive therapeutic tactics. He is not primarily concerned with the particular type of insanity, but with a careful and accurate diagnostic estimate of: "(*a*) The physical machine as a whole. (*b*) Disease and physical damage of organs. (*c*) Functional derangement of viscera. (*d*) An estimate of the effect of these on the nutrition of the brain through damage to its nutritional medium (the blood) by alteration in its content (anemia, etc.), or by the addition of toxic material from one or more organs. (*e*) Psychogenic factors. (*f*) Mental symptoms." The mode of treatment is strictly individualized and takes its keynote from the carefully accumulated fund of diagnostic information. In addition, there are certain measures which find free application. They include rest, fresh air, postural and gymnastic therapy, occupation, hydrotherapy, discipline, etc. They are given with minute and unswerving attention to detail. Under such a diagnostic therapeutic regimen 80 per cent. of the patients with adolescent psychoses recover.

Strecker, Philadelphia.

INTERMITTENT CLAUDICATION. H. Schlesinger, Med. Klin. **17**:1507 (Dec. 11) 1921.

Intermittent claudication is characterized by pains, muscle cramps, severe paresthesias, limping and even profuse perspiration occurring in the lower limbs on walking, subsiding rapidly with rest but again precipitated when walking is resumed. Arterial pulsation in the affected limbs is usually impaired, and vessel changes are as a rule demonstrable.

The diagnosis, while relatively simple, is frequently missed because of an inadequate history and the failure to palpate the arteries in the feet.

Persistent neuralgias, ischalgias, meralgia paresthetica, tarsalgia, and flatfoot should always suggest an examination of the pedal arteries. Muscular rheumatism and hip joint diseases are not infrequently confused with a claudication.

Erb was the first to postulate an arterial change as the etiology of intermittent claudication. Nicotin, exposure, diet and nervous influences are mentioned as factors in the production of this disturbance. Impaired venous circulation and thrombus formation are occasionally found, but as a rule varicosities do not play a part in the picture.

It is not uncommon to find associated with claudication a neuritis which does not disappear on rest. The neuritis is apt to be unilateral accompanied by loss of Achilles and patellar reflexes and some sensory changes. The neuritis usually clears up with improvement in the circulation.

Vasomotor phenomena are frequently present and show themselves in various ways. There may be arterial contraction, with pallor of the affected limb and decrease in temperature. This may persist even when the limb is placed in the horizontal position. Occasionally in place of the arterial contracture a dilatation occurs. A rather unusual phenomena is the production of blanching in the affected limb by local heat. Vasodilator drugs tend to cause a reaction in the diseased limb in preference to the sound one. Thus an injection of sodium nitrite will produce redness and increased warmth in the affected limb for several hours.

The prognosis, according to the author, is not entirely hopeless. A rigid prophylaxis is of the utmost importance. Exertion and exposure should be avoided. Smoking should be discontinued as these people seem to have an idiosyncrasy for nicotin. In spite of the usually accepted opinion that heat is beneficial, the author believes that more harm than good results from it. Moderate heat may be employed. In the protection from cold maceration must be avoided. Galvanization, as recommended by Erb, has produced good results.

Internal medication in the form of theobromin, aspirin and nitroglycerin is recommended. Sodium nitrite if used must be given subcutaneously. The latter method, in the hands of the author, has been most successful. Strychnin has also been employed. Wieting's operation—the planting of the femoral artery into the femoral vein—is not to be recommended.

In the author's experience the results are much better than one might suppose from a review of the literature. Long remissions with return of function and ability to resume work are not uncommon.

Moersch, Rochester, Minn.

THE EFFECT OF TRANSPLANTING A PORTION OF THE NEURAL TUBE OF AMBLYSTOMA TO A POSITION AT RIGHT ANGLES TO THE NORMAL. H. L. Wieman, J. Exper. Zoology **35**:163, 1922.

When a small section of the neural tube of Amblystoma (equal to the length of two somites), at the stage of the closed neural folds, is removed at the level of the second to fourth somites, together with portions of adjacent somites, and reimplanted at right angles to its normal position, the transplanted tube continues its development and retains its original polarity. A preliminary dorsal flexure of the body occurs, owing to contraction accompanying the closure of the wound, followed by straightening and a ventral flexure. When the notochord was cut and moved as a part of the transplant, the ventral bending was practically absent. Another general effect of the operation was the underdevelopment of the gills. The embryos were tested for nervous conductivity by delicate tactile stimuli.

The growing brain, pushing the anterior stump back against the anterior side of the transplanted tube, may be a factor in forming a union at the point of contact. Nerve fibers grow back from the anterior stump into the transplant near its original anterior end. The posterior stump becomes club-shaped but shows no initial tendency to send fibers forward into the transplant. A connection between the transplant and the posterior stump is brought about by the continued growth backward of fibers from the anterior stump through the transplant. Ascending fibers then grow forward from the posterior stump. The transplant eventually becomes absorbed in the reconstructed neural tube, but the appearance of sections shows that the cells of the transplant do not lose their original polarity as late as thirty to forty days after operation. The results point to the formation of the long motor tracts from the brain to the cord before the sensory tracts. The restoration of nervous connections through the transplant takes place in the direction of the normal metabolic gradient of the embryo.

When the operation is performed at a stage just before the larvae become sensitive, the process is the same, but the union is formed in a shorter time after operation. When the operation is performed at the earlier stages, but in the region of the fifth and sixth somites, or farther back, a longer time is required for the formation of nervous connections. In a series of twelve operations no case of complete connections between the stumps occurred in thirty days. In one case at least the transplant was disintegrated at the end of thirty days. If the initial step in the restoration process is a posterior growth of fibers from the brain to the transplanted tube, the longer time required for fibers to reach the more posterior level would allow somites transplanted with the tube to develop to such an extent as to delay or prevent the formation of a nervous connection. The nearer to the brain the transplantation is made the better the chances for connections to be established.

Wyman, Cambridge, Mass.

AN UNUSUALLY ACUTE CASE OF MULTIPLE SCLEROSIS WITH ANATOMIC FINDINGS. Von Weizäker, Monatschr. f. Psychiat. u. Neurol. **49**:221 (April) 1921.

It is very difficult to make a differential diagnosis between certain cases of multiple sclerosis and the encephalitides and myelitides. The line of demarcation between the two seems constantly to be growing more indefinite; this is true on the anatomic as well as on the clinical side. There is an increasing tendency to assume an inflammatory origin for multiple sclerosis. Confirmation of this view would explain why one finds all transitions between the two types of diseases.

A patient aged 57, had syphilis at the age of 17. He received six courses of treatment. Eight years ago he had diplopia of short duration. The present illness began eight days before admission to the hospital, with headache, weakness, instability of gait, weakness of the hands and a dead feeling in the little finger. Then diplopia and hiccup began. On admission he had fever, cyanosis and stupor. The pupils were equal, reaction to light slow, convergence reaction normal. He had moderate ataxia which was increased on closing the eyes. The spinal fluid findings were: globulin one plus, cell count 20, Wassermann test (0.2-1 c.c.) negative. The blood Wassermann test was also negative.

The patient had fever and perspired. The reflexes remained normal. There was a certain rigidity of the muscles, and the face was somewhat masklike. The stupor gradually deepened. Death occurred fourteen days after the first prodromes, ten days after the actual onset of symptoms.

At necropsy there was no evidence of syphilis. In the white matter of the cerebrum, pons and cerebellum were a few foci which differed in no respect from the plaques of a chronic multiple sclerosis. In addition, there was an acute process, most marked in the pons and medulla, but extending into the upper cord. The acute changes were most extensive in the gray matter, but also involved the white matter. They included definite ganglion cell degeneration with neuronophagia and a marked glia reaction. There was a general reaction of the vascular connective tissue with small round cell infiltration throughout the vessel walls.

The anatomic and the clinical picture both showed an acute process superimposed on a chronic. Unquestionably the plaques were plaques of multiple sclerosis. The difficulty arises in the interpretation of the acute changes. These were changes which one might find either in an acute multiple sclerosis or in an acute encephalitis, especially a lethargic encephalitis. How shall we interpret them?

The author feels justified in considering the case one of multiple sclerosis because of the typical plaques in the white substance with sparing of the cortex, with special involvement of the medullary sheaths, and with marked productive glia reaction. If we accept this view, and do not assume two separate diseases, this case supports the views of those who, with Marburg, Anton and Wohlwill, Jacob and others, believe that the acute patch of multiple sclerosis differs in no respect from the lesions of such definitely exogenic diseases as myelitis, poliomyelitis and lethargic encephalitis.

In this case the acute phenomena dominate the picture; the typical chronic plaques are subordinate. Clinically the only sign pointing to the possible development of a multiple sclerosis was the diplopia which was present eight years ago.

As long as we cannot demonstrate the causative agent, we cannot give a positive answer to the question. The author favors the grouping of this case as a multiple sclerosis.

Selling, Portland, Ore.

STUDIES ON SPATHIDIUM SPATHULA. I. THE STRUCTURE AND BEHAVIOR OF SPATHIDIUM, WITH SPECIAL REFERENCE TO THE CAPTURE AND INGESTION OF ITS PREY.

Lorande Loss Woodruff and Hope Spencer, J. Exper. Zoology **35**:189, 1922.

Pedigreed cultures of Spathidium were kept in moist chambers and fed on beef extract plus hay infusion seeded with small ciliates, chiefly Colpidium. The typical vegetative form is flask-shaped, but encystment, division, conjugation and starvation alter the typical form. There are sixteen longitudinal, double rows of cilia evenly distributed over the cell. At the edge of the truncated anterior end there are two rows of longer, stouter, cilia. The cytostome is a long, narrow depression extending nearly the length of the truncated end at right angles to the axis of the cell. Spathidium does not possess trichocysts, and consequently the extrusion of such structures is not responsible for the paralysis of the prey. Trichites are present in the oral region and form a paling which is apparently comparable with the supporting rods about the mouth in the more generalized gymnostomatous ciliates. There is no conclusive evidence that the trichites are the locus of the poison. There is one large contractile vacuole at the posterior end of the cell. In the typical vegetative cell are two long, ribbon-like macronuclei which extend nearly the whole length of the cell. There are from six to nine micronuclei. Therefore the Spathidium studied by Moody must be interpreted as an amicronucleate race.

The food of Spathidium is limited to small ciliates but not to members of the genus Colpidium. Spathidium swims forward quite rapidly, revolving on its long axis. In general its behavior can be interpreted in accordance with the "avoiding reaction" as worked out by Jennings. When a swimming Spathidium is stimulated it reverses its cilia, moves back a little and then proceeds in a slightly different course. When the anterior end strikes a small ciliate the prey becomes motionless and exhibits pathologic changes. If the prey is instantly paralyzed and remains against the oral region of its captor, the Spathidium gives a few rapidly repeated avoiding reactions, the prey is encircled by the cytostome and sinks into the endoplasm. Ingestion takes place in about thirty seconds. If the prey is not instantly paralyzed and moves a short distance away, the behavior of the Spathidium is not identical in any two cases. In general the Spathidium gives a series of avoiding reactions until sooner or later its mouth is in contact with the food. The reactions are modified and complex, indicating "sensing at a distance." The factor involved in this "sensing" is apparently a chemical substance secreted by the Spathidium when the prey is paralyzed, because the prey is a center of attraction for other Spathidia in the neighborhood, and the oral region of the Spathidium in question is also a stimulus to neighboring specimens. Spathidium comes in contact with its prey solely by chance.

Wyman, Cambridge, Mass.

SYPHILIS AND TRAUMA: THE WORKMEN'S COMPENSATION ACT, THE INDUSTRIAL PHYSICIAN AND THE SYPHILITIC EMPLOYEE.

Joseph V. Klauder, J. A. M. A. **78**:1029 (April 8) 1922.

A latent syphilitic infection in some cases may play an important rôle as a factor in the immediate and late consequences of trauma. The matter of compensation in cases of injury to workmen and syphilitic soldiers during the recent war has made the question of the relationship of trauma to syphilitic lesions a most important one. It is known that trauma may determine the site of tuberculous lesions, particularly of the bones and joints, and the same is true for other conditions, such as psoriasis; in reference to syphilis the relationship to trauma has been noted in relationship to chancre and to the mucous patches of syphilitic glossitis in excessive smokers. Spirochetes from the blood may be deposited at the traumatized site. The phenomenon allergy, or the hypersensitive state of syphilized tissue, doubtless plays a rôle in the influence that trauma exerts in causing syphilitic lesions. Because of the allergic state of syphilized tissue, it is perhaps possible that trauma, a nonspecific irritant, acts as a stimulant to this tissue, causing it to react in a characteristic manner in the absence of the specific irritant, namely, *Spirochaeta pallida.*

Dr. Klauder says that the fact that the workman had a preexisting disease —syphilis—does not alleviate the responsibility of his employer for compensation for injury, disability or death indirectly due to syphilis. The fact of trauma being able to influence the course of a patient with syphilis makes the examination of industrial workers one of great importance. An examination of the spinal fluid of all syphilitic workmen is, of course, impossible, but the most important and perhaps the first objective sign of neurosyphilis is pupillary abnormality, and while these changes are not an infallible symptom of neurosyphilis, they are suggestive. The author believes that a syphilitic workman with pupillary abnormalities on the clinical side, and a positive spinal fluid on the laboratory side, is a potential candidate for paresis if he is retained in a position of a hazardous nature in which he may sustain trauma. Such an employee should be given other work.

Nixon, Minneapolis.

CONSTRUCTIVE FORMULATION OF SCHIZOPHRENIA. Adolf Meyer, Am. J. Psychiat. **1**:355 (Jan.) 1922.

Under this title Dr. Meyer calls our attention to the "potentially modifiable points" of dementia praecox reactions. He is interested, as are all who have a psychatric bent, in the manic-depressive patient who becomes demented and in the dementia praecox patient who recovers. There is nothing so worthy of consideration as the schizophrenic process; occasionally a physician with a certain understanding of this process helps a patient through a crisis which means life or death.

In describing his method of studying a patient, Dr. Meyer uses some terms not frequently used. In a given case he would rule out the organic brain diseases and the infective-toxic reactions; he would then differentiate the psychoneuroses from the wide group of more functional disorders which concern the whole person and include exhilarations, depressions, schizophrenic reactions and transition forms. In the latter group, he would make a close study of the affect and set such impure manifestations as fear and tension against the pure elations and depressions. The content must also be examined to determine how well it fits in with the affect; if it does not fit in and cannot be explained by the influence of toxins or infections, the patient probably has schizophrenia which is an "ominous," but not a hopeless condition. Each patient's response to efforts of adjustment must be tested, and in that test lies considerable hope. Certainly every one working with mental patients should be familiar with this point of view and understand the claim that "terminology is an absolute secondary issue" while the "summary formulation of the facts is primary."

In a paragraph Dr. Meyer calls attention to the need of study of the unmeasured metabolic symptoms, which include unaccountable fever, refusal of food and incongruous pupil reactions, which are so prominent in patients with mental disease that it is remarkable that they have been neglected.

Bond, Philadelphia.

THE TREATMENT OF MULTIPLE SCLEROSIS. Charles Metcalf Byrnes, J. A. M. A. **78**:867 (March 25) 1922.

The author emphasizes the fact that care must be exercised in the differentiation of lesions of multiple sclerosis as there is a striking analogy in the symptomatology and pathology of insular sclerosis and certain types of cerebrospinal syphilis. The lesion in multiple sclerosis in all probability is of an inflammatory nature. There are cellular reactions which resemble those of syphilis and, with the exception of the reaction to the Wassermann test, the spinal fluid exhibits changes comparable to those in vascular and gummatous types of cerebrospinal syphilis. He thinks the failure to demonstrate *Spirochaeta pallida* or to secure a positive Wassermann reaction in all cases is no proof that syphilis may not be an etiologic factor. On the other hand, a positive Wassermann reaction in multiple sclerosis does not establish its specific nature, since the two conditions may exist simultaneously or, in such instances, the disease is syphilis and not multiple sclerosis. For this reason the therapeutic test is of no value as a diagnostic measure.

While syphilis may not be an etiologic factor there are undoubtedly clinical types of disseminated syphilis that are not distinguishable from insular sclerosis so that until the etiology of the latter disease is established, or a more successful form of treatment found, the author believes the adoption of antisyphilitic treatment is worthy of consideration, and that the treatment is more likely to be effective if begun early. He recommends both intravenous and intradural medication.

Nixon, Minneapolis.

THE TEMPERATURE SENSES IN THE FROG'S SKIN. Ann Haven Morgan, J. Exper. Zoology **35**:83, 1922.

Receptors for heat and cold were demonstrated in the frog's skin by suspending a reflex frog and dipping the foot into water of various temperatures. The lowest degrees of heat which stimulate the skin lie somewhere between 35 C. (95 F.) and 41 C. (105.8 F.). The first responses to cold occur at 10 C. (50 F.). As the heat is increased the reaction times decrease regularly from long intervals to short ones (25 seconds to 1 second). The interval between stimulation by cold and the response was an inconsiderable period. The typical response to heat is an upward jerk of the leg. The typical response for cold is a rigidity and tenseness of the muscles, but there may be an upward jerk. It is impossible to stimulate the foot of a reflex frog by gradually increasing the temperature without response, the first response occurring at 43 C. (107.4 F.). The reaction times indicate that the heat receptors are in the deeper and the cold receptors in the more superficial layer of the skin. The sense of heat may be affected by treating the foot with cocain solution, and both the sense of heat and that of cold may be wholly eliminated by cutting the sciatic nerve or by removing the skin. Treatment with cocain entirely removes the sense of cold. It has been possible to isolate the temperature sense from the tactile, pain and chemical senses by treating the foot with cocain solution and stimulating it by dropping shot on it, pricking the toe with a needle or treating the foot with acid. Responses to heat and cold persist beyond response to touch. Pain persists beyond heat and cold. Response to acid (0.5 per cent. hydrochloric) persists beyond response to heat or cold. Heat persists beyond cold. The receptors are well defined.

Wyman, Cambridge, Mass.

SEQUELS OF ACUTE EPIDEMIC ENCEPHALITIS: A STUDY OF NINETY-TWO CASES FROM ONE TO THREE YEARS AFTER RECOVERY. Morris Grossman, J. A. M. A. **78**:959 (April 1) 1922.

In recent months several papers have appeared showing that earlier rather optimistic prognoses in cases of epidemic encephalitis were not altogether justifiable. Further, the seriousness of the paralysis agitans syndrome both from the standpoint of the outlook of those presenting that picture at the beginning and of the possibility of patients who had apparently recovered acquiring this syndrome months after the original attack is being noted.

Of the ninety-two cases reported only ten patients had fully recovered; fourteen were functionally well, two remained stationary and four showed some improvement. Sixty-two of the ninety-two patients showed evidence of a more or less progressive involvement of the central nervous system, and of this group forty-two patients presented a clinical syndrome closely resembling that of paralysis agitans. Nearly 70 per cent. of the parkinsonian group were under 30 years of age and, in contrast to true paralysis agitans, a large number of these patients showed pupillary changes and residual signs pointing to cranial nerve involvement; the facial nerve most frequently presented abnormalities.

The remaining twenty progressive cases showed various types of motor disturbance, such as choreiform and choreo-athetoid movements, ticlike movements of the head, torsion spasm of the pelvis and leg, myasthenia gravis and spontaneous tremors.

It is obvious from a study of this group of patients that the danger from epidemic encephalitis does not pass when patients recover from the acute illness.

Nixon, Minneapolis.

THE NATURE OF FUNCTIONAL DISEASE. William McDougal, Am. J. Psychiat. **1**:335 (Jan.) 1922.

In this day of insistence on the somatic causes of mental disease, it is interesting to read a paper which insists on the independence of the mind. Dr. McDougal believes that the too persistent search for structural defects has retarded psychiatry and that function will determine structure. If we find a disordered organism (hallucinations) with no structural defect visible, we cannot assume that with better methods we could always find the mechanical defect. The organism differs from a machine because its purpose lies within itself and it is regulated and adjusted from within. He insists on the importance of timing relations. "Paralyses and contractions, which play so large a part in the picture of functional disorders, may properly be regarded as due to . . . breakdown of the power of adjustment of time relations." "Purpose works . . . by timing the spark." The compositor unfortunately makes this determine "the moment of the conversion of potential to lunetic (sic) energy."

Cases of dementia praecox reported by Jung and Forsyth are given to show the apparent onset of the disease under unfavorable mental influences and improvement or recovery on the removal of bad or the adding of better mental factors. The consideration of Motts' pathologic studies leads the writer to suggest that diminution of function may produce the structural changes which are found and to say that such studies do not establish precedence in time. Finally, the writer says, "I believe that the mind has a nature and structure and functions of its own which cannot be fully and adequately defined in terms of structure of the brain and its physical processes." Or, there may be "mental diseases which are of the mind only and not at all of the body."

Bond, Philadelphia.

ANATOMIC STUDY OF INJECTION OF SECOND AND THIRD DIVISIONS OF TRIGEMINAL NERVE. F. C. Grant, J. A. M. A. **78**:794 (March 18) 1922.

Injections into the second and third divisions of the nervus trigeminus have become a common procedure. They were used primarily almost only for the relief of trigeminal neuralgia; the present indications for blocking these nerves include many dental and surgical manipulations on the face and jaws.

Most of the descriptions of the technic of these injections are disappointing in their practical application. To reach successfully a nerve trunk lying deep beneath the skin and emerging from bony orifices in the skull, definite landmarks and angles are required as guides to the approach. In the clinic with which Dr. Grant is connected there has been developed an instrument called a zygometer which aids in determining accurately the point on the face at which the needle should be introduced to reach a particular nerve trunk; using this instrument to standardize the points of insertion of the needle through the skin, the angles in the horizontal and vertical plane through which the needle must pass from this fixed surface point to enter the nerve trunk have been worked out. Details of the application of this procedure are given.

Nixon, Minneapolis.

THE IMPORTANCE OF ENDOCRINE THERAPY IN COMBINATION WITH MENTAL ANALYSIS IN THE TREATMENT OF CERTAIN CASES OF PERSONALITY DEVIATION. Edith R. Spaulding, Am. J. Psychiat. **1**: No. 3 (Jan.) 1922.

Spaulding presents four patients who were brought to a social adjustment by a combination of mental analysis and reeducation plus ductless gland therapy. The diagnoses were manic-depressive psychosis, psychopathic personality, psychoneurosis with antisocial tendencies and emotional imbalance. In three instances there was principally pituitary deficit and in one an overactive thyroid gland. The author deplores the singleness of approach to the individual patient which is largely dictated by the scientific inclination of the particular physician who studies the case. It is emphasized that the need is often twofold, and it is suggested that the psychiatrist enroll the endocrinologist as his chief aide. It might be added that especially in considering the problem of delinquency, the need may be even greater, and that it is often useless to take therapeutic steps until one has clearly in mind and is able to assign a proper place to all the psychogenic and physical liabilities and assets.

Strecker, Philadelphia.

CLINICO-ANATOMIC STUDY OF A FATAL CASE OF MYASTHENIA (ERB-GOLDFLAM). P. Marie, H. Bouttier and Bertrand, Ann. de méd. **10**:173 (Sept.) 1921.

The report relates to a case of progressive bulbospinal myasthenia of the Erb-Goldflam type. (Previously reported by Marie and Bouttier in the *Bull. et mém. Soc. méd. d. hôp. de Par.,* April 30, 1920.)

In the present anatomicopathologic report, two points are of great importance.

Systematic examination of the central nervous system did not yield evidence of a nervous lesion. In particular, examination of bulbar, protuberantial and peduncular nuclei demonstrated integrity of their constituent cells. Thus, one can observe the classical picture of an Erb-Goldflam progressive bulbospinal myasthenia in the absence of nuclear changes.

In contrast to this integrity of the nerve centers, there were lesions throughout the suprarenal and muscular systems. Small lymphoid nodules were disseminated through the muscles. The suprarenal lesions were in the medullary zone and reticular substance.

The authors conclude that Erb's myasthenia rests on suprarenal-muscular system disease, the precise nature of which they do not try to give.

Davis, New York.

PALLIATIVE CONTROL OF THE GASTRIC CRISES OF TABETIC NEUROSYPHILIS BY THE RECTAL ADMINISTRATION OF CHLORAL HYDRATE AND SODIUM BROMID. Albert R. McFarland, J. A. M. A. **78**:786 (March 18) 1922.

In the effort to devise an improvement on the morphin hypodermic for the relief of the patient with gastric crisis the author tried many drugs, using different methods of administration. He found that large doses of chloral hydrate and sodium bromid by rectum gave the best results.

The injection is preferably given at bedtime and consists of an aqueous solution of chloral hydrate and sodium bromid so prepared that one-half ounce (15 c.c.) of the fluid contains 40 grains (2.6 gm.) of each drug. The patient's hips are elevated by a pillow, and the solution is allowed to flow slowly under gravity pressure through a catheter introduced 15 cm. (6 inches) into the rectum. The patient is instructed to retain the injection. The room is then darkened, and the patient is kept quiet in bed. For persons weighing over 150 pounds (68 kg.), as high as 60 grains (3.9 gm.) of each drug at one dose can be given.

Of the twelve patients who were treated by this method nearly all had obstinate and severe cases. In all, forty-nine injections were given and definite relief was obtained in 76 per cent. of the forty-nine administrations. The last injection was apparently as effective as the first. Gastric lavage was used in two cases and seemed to be a valuable adjunct to treatment, especially if there was evidence of gastric distention.

Nixon, Minneapolis.

Society Transactions

NEW YORK NEUROLOGICAL SOCIETY

Stated Meeting, Feb. 7, 1922
Foster Kennedy, M.D., *President, in the Chair*

DYSSYNERGIA CEREBELLARIS MYOCLONICA, PRIMARY ATROPHY OF THE DENTATE SYSTEM. Dr. J. Ramsay Hunt.

Some years ago, under the title dyssynergia cerebellaris progressiva or chronic progressive cerebellar tremor, Dr. Hunt directed attention to a peculiar disorder of motility, which he regarded as a definite clinical type of nervous disease. This condition was characterized by generalized intention tremors, which began as a local manifestation and gradually extended to other parts of the voluntary muscular system. The extremities, especially the arms, showed the greatest degree of involvement. When this tremor disturbance was subjected to careful analysis there was found associated with it a disorder of muscle tone and of the ability to measure, direct and associate muscular movements, the clinical manifestations of which were dyssynergia, dysmetria, adiadokokinesis, hypotonia and asthenia. All of these symptoms, including the volitional tremor, which was an extreme expression of the underlying disturbance of muscle tone and synergy, indicated a fundamental disorder of cerebellar function. Dr. Hunt, therefore, regarded the condition, with its progressive tendency, chronic course and well-defined cerebellar symptomatology as "an organic disease caused by degeneration of certain special structures of the cerebellar mechanism, which were concerned in the regulation of the tonus and synergies of muscles."

Since Dr. Hunt's original publication, he has observed another group of cases which combined the symptomatology of dyssynergia cerebellaris progressiva and myoclonus-epilepsy—the progressive dyssynergia characteristic of a cerebellar disorder in association with epilepsy and myoclonus. As in the group of cases uncomplicated by myoclonus-epilepsy, the movements of the extremities showed the greatest degree of disturbance.

This form of dyssynergia, which Dr. Hunt would term dyssynergia cerebellaris myoclonica, he has also observed in association with Friedreich's ataxia, a combined cerebellospinal involvement, which is not infrequent in the history of cerebellar system disease. Careful investigations were made of the pathologic condition in one of these cases, which throw considerable light on the origin and anatomic basis of the cerebellar portion of the symptomatology. There was a primary atrophy of the efferent dentate system of the cerebellum, and this system was regarded as the essential neural mechanism underlying the production of cerebellar or intention tremor.

Clinical Summary of Four Cases.—Case 1.—Myoclonus-epilepsy began at the age of 17, and was followed five years later by symptoms of dyssynergia cerebellaris progressiva—generalized intention tremors and scanning speech, associated with dysmetria, dysdiadokokinesis, hypotonia and asthenia. With the exception of epilepsy, myoclonus and dyssynergia, there was no evidence of organic disease of the nervous system. The dyssynergia was appendicular rather than trunkal in distribution, and the higher types of movement were chiefly affected. There was no familial history of either myoclonus-epilepsy or cerebellar disease.

Case 2.—A girl, aged 19, developed myoclonus-epilepsy at the age of 7, associated with a progressive dyssynergia of cerebellar origin, affecting especially speech and the extremities. The chief disorder of the cerebellar function was of articulation and the movements of the extremities. The gait and general equilibrium also showed some disorder of cerebellar function which was accentuated by a severe type of myoclonia. The dyssynergia, while preponderantly appendicular in distribution, also involved the trunkal musculature to some extent. There was no history of the familial occurrence of either myoclonus-epilepsy or cerebellar disease.

Case 3.—In this patient the myoclonus-epilepsy, of twenty-six years' duration, was associated with symptoms of dyssynergia cerebellaris progressiva: cerebellar dysarthria, intention tremor, dysmetria and adiadokokinesis, affecting chiefly the volitional movements of the extremities. With the exception of myoclonus-epilepsy and dyssynergia, there were no symptoms of organic disease of the central nervous system. Symptoms indicative of multiple sclerosis, Friedreich's ataxia or gross cerebellar disease were not present. There was no familial history of either disorder.

Case 4.—A girl, 15 years of age, with nocturnal epilepsy, had myoclonia and slight cerebellar dyssynergia of three years' duration. This case represents a somewhat earlier stage of dyssynergia cerebellaris myoclonica. There is no family history of myoclonus-epilepsy or of cerebellar disorder.

Remarks.—The association of cerebellar dyssynergia and myoclonus-epilepsy in this group of cases suggests the occurrence of two independent nervous disorders in one person. Combined forms of the various congenital, familial and hereditary types of nervous disease are not uncommon, and these associations are especially frequent in the spinal and cerebellar groups of systemic diseases. Jendrassik, who has devoted particular attention to this subject, records many such combinations. Such combinations, however, are rare and show merely a predisposition to the two disorders in the same person and would not necessarily indicate an essential relationship between them. On the other hand, little is known of the pathology and localization of myoclonus. Its occurrence, therefore, in conjunction with a special type of cerebellar disease is not without interest and may have a deeper pathologic significance than is apparent.

Dyssynergia Cerebellaris Myoclonica Associated with Friedreich's Ataxia.—Dr. Hunt presents another group of cases in which myoclonus-epilepsy and dyssynergia cerebellaris progressiva were associated with symptoms of Friedreich's ataxia.

Case 5.—A man, aged 36, had had symptoms of myoclonus-epilepsy since his twenty-first year. Previous to this there were symptoms of Friedreich's ataxia and progressive cerebellar tremor which steadily progressed. Study of the pathology of the condition showed the typical spinal lesions of Friedreich's ataxia associated with primary atrophy of the efferent dentate system of the cerebellum, considerable diminution in number and extensive atrophy of the cells of the dentate nucleus, with secondary atrophic changes in the superior cerebellar peduncles.

This case differs from those described in the previous series in two respects: the association with Friedreich's ataxia and the familial incidence; a twin brother suffering from the same disease. The first symptoms of the cerebellospinal disorder made their appearance during the early juvenile period. The myoclonus-epilepsy did not become manifest until the patient's twenty-first year. The presence of the spinal symptoms of Friedreich's ataxia would mask many of the typical symptoms of cerebellar disease. Marked intention tremors and scanning speech indicated clearly, however, cerebellar involvement (cerebellar tremor), and this was confirmed by histologic examination.

Case 6.—A man, aged 29 years, the twin brother of the patient in Case 5, had had symptoms of dyssynergia cerebellaris and Friedreich's ataxia for the last ten years, gradually increasing in severity. Myoclonia developed five years ago, and the epilepsy was only of three years' duration. This case, like that of his brother, presents symptoms of dyssynergia cerebellaris progressiva, myoclonus-epilepsy and Friedreich's ataxia in combination.

Histologic Examination of the Central Nervous System.—Summary of Pathologic Changes: Histologic study of the central nervous system of the patient in Case 5 showed the typical spinal cord changes in Friedreich's ataxia. There was atrophy of the posterior columns of the cord which could be traced to the nuclei of Goll and Burdach in the medulla. Atrophic changes were also present in the direct cerebellar tract of Flechsig and the tract of Gowers (ventral and dorsal spinocerebellar tracts). The columns of Clarke were atrophic, and there were also some changes in the area occupied by the spinothalamic tracts.

There was no definite atrophy of either the direct or crossed pyramidal tracts, and the slight pallor in certain areas could be ascribed to degeneration of other nonpyramidal fibers in this region.

Histologic study of the brain-stem and cerebellum revealed an extension into the medulla of the system atrophies of the cord—the direct spinocerebellar tracts. The atrophy of the posterior columns apparently ceased at their termination in the nuclei of Goll and Burdach for the fibrae internae arcuatae were well preserved and the corpus restiform well developed.

The other important and essential lesion was an atrophy of the motor cells of the corpus dentatum of the cerebellum and of their efferent neurons in the superior cerebellar peduncles. There was no atrophy of the other cerebellar systems and none of the nucleus ruber. The lesion was therefore confined to this short and important internuncial common path which conveys the motor impulses of cerebellar origin to the spinal pathways. The lesions were therefore both spinal and cerebellar. The spinal lesion was that common to Friedreich's ataxia; Dr. Hunt would regard the cerebellar lesion as a primary atrophy of the efferent dentate system of the cerebellum.

Primary Atrophy of the Efferent Dentate System and Its Relation to Dyssynergia Cerebellaris Progressiva (Progressive Cerebellar Tremor).—We may recognize these pathologic types of cerebellar atrophy: the cerebellar cortical type of André Thomas; the olivocerebellar type of Holmes and the olivo-rubro-cerebellar type of LeJonne and L'Hermitte. Dr. Hunt would add the primary atrophy of the dentate system. This is a systemic disease characterized by atrophy of the cells of the dentate nucleus and thinning of the superior cerebellar peduncles. All other important structures of the cerebellum—the cortex, the olivocerebellar and pontocerebellar systems—are intact. In medical literature there are a number of isolated facts tending to show the close connections between what the author terms the dentate system and cerebellar or intention tremor. The relation of intention tremor to the cerebellorubral system was emphasized some years ago by Gordon Holmes. Sanders and Touch have also reported cases of intention tremor in association with lesions of the dentate nucleus. In the experimental field, the work of Ferrier and Turner on monkeys has also shown the relation of the cerebellar or intention tremor to the efferent cerebellar system.

As the pathologic changes in the case just recorded are limited to the neodentate system of the cerebellar mechanism, it is only natural that the more recently acquired, and more highly differentiated, motor activities should show the greatest degree of involvement. This system is related to the neocerebellum and its recently acquired function. Dr. Hunt believes that for this reason the condition is predominantly appendicular in its manifestations and intention tremor so conspicuous a symptom. The neodentate portion of the efferent cerebellar system shows greater vulnerability to abiotrophic degeneration.

The clinical syndrome which we term myoclonus-epilepsy probably includes a variety of clinical and pathologic types. Lafora and Glueck, and more recently Westphal and Sioli, have described a chronic progressive disorder of the central nervous system, characterized by epilepsy, myoclonus and progressive dementia. In one case, typical cerebellar symptoms were present with scanning speech, cerebellar ataxia and tremor. Necropsy revealed in both cases a peculiar amyloid degeneration of the ganglion cells which was widely distributed in the various aggregations of gray matter in the brain and spinal cord.

An interesting case of cerebellar atrophy associated with myoclonus has been described by Haenel and Bielschowsky. In addition to the typical clinical picture of a cerebellar disorder, there were symptoms of paramyoclonus multiplex. Careful histologic examination revealed only an extensive atrophy of the cerebellar cortex, of the inferior olive and of the olivocerebellar tracts. Pathologically the atrophy was primary and confined to certain definite systems of the cerebellum and belonged to the olivocerebellar type of cerebellar atrophy. It is interesting to note that the essential lesions in this case were confined to the cerebellar cortex and the cerebellofugal system of the first order. The slight changes in the nucleus dentatus and superior cerebellar peduncles, Bielschowsky regarded as secondary in character, following atrophy of the cortical neurons. If myoclonus, therefore, has any functional relationship to the cerebellum, it may exist in association with both types of primary cerebellar atrophy—the olivocerebellar type described by Holmes and the atrophy of the efferent dentate system.

DISCUSSION

Dr. S. P. Goodhart: Dr. Hunt has added considerably to a rather rare set of cases. I have not had the opportunity to see so many. I think it would be interesting to consider Dr. Hunt's proposition, which he has sustained by histologic examination and theoretical hypothesis. He has taken an unusual conception of cerebellar involvement. Our own idea does not embrace myoclonic movements. It is suggestive that the cerebellum is associated with that type of movement as explained by Dr. Hunt. I think, however, it is well to consider the relationship of the corpus striatum in cases of progressive cerebellar dyssynergia. The corpus striatum is certainly involved in some cases, and it seems to me that before we can definitely place this syndrome there should be more investigation and checking of necropsy findings, giving special attention to the larger cerebellar system and taking the corpus striatum particularly into consideration. In one case particularly, a definite lesion was found in the striatal wall, and there was also involvement of the nucleus dentatus. The peculiarities of the striatal movements, however, would make it unsafe to place the entire syndrome in the literature without considerable confirmatory evidence. I think that Dr. Hunt has given us an admirable conception and has put us in contact with a syndrome not often seen. I should like to know why Dr. Hunt associates this myoclonia, so frequently seen with epilepsy, with the cerebellar mechanism.

Dr. E. D. Friedman: Dr. Hunt found degeneration of the superior cerebellar peduncles in one case. If that is so, may I ask Dr. Hunt whether he has noticed any choreiform movements in his cases? Both Forster and Bonhoeffer have associated choreiform movements with lesions involving the brachium conjunctivum. No one to my knowledge has thought of associating lesions in this area with myoclonic movements.

Dr. J. Ramsay Hunt, closing: My patients did not have motor disturbances of the choreiform type. Myoclonus and intention tremor were present, but no chorea in the technical sense.

Replying to Dr. Goodhart, these cases were cited as representing a clinical and not a definite pathologic type. For example, we recognize myoclonus as having a wide range of symptomatology, and we also recognize epilepsy as having the same wide range of incidence. When these two manifestations appear in conjunction we recognize myoclonus-epilepsy. We do not know the reason for this association, as it is probable that several pathologic conditions are involved in myoclonus-epilepsy. Nevertheless, it constitutes a clinical type or syndrome. In this sense I would regard dyssynergia cerebellaris myoclonica.

Here is a group of patients of which six have come under my personal observation, who had myoclonus-epilepsy and a progressive cerebellar dyssynergia. The relation of these symptoms to each other cannot be determined at this time. My pathologic studies of one case, associated with Friedreich's ataxia, showed a primary system disease of the cerebellar mechanism: atrophy of the dentate nucleus and of the superior peduncles. The cerebellar symptoms I would refer to atrophy of the dentate system. This is the chief efferent system of the whole cerebellar mechanism, and bears the same relation to the cerebellum that the pallidal system bears to the corpus striatum. The relation of myoclonus to a cerebellar disorder is not without interest. In Bielschowsky's case there was a pure system disease which involved the cerebellar cortex and the connections with the dentate system. There were also atrophic changes in the dentate system, but these Bielschowsky regarded as secondary. It is, however, significant that my case which involved the dentate system with its motor neurons of the second order, and Bielschowsky's case which involved the motor system of the first order, were both associated with myoclonus. So far as I am aware, this symptom has not been reported with other types of cerebellar system disease.

I refer to my conception of the static and kinetic system of motility, and to the cerebellum as the essential organ for the control of static or postural synergies. It is conceivable that disorders of the posturing mechanism might give rise to myoclonic types of movement, the result of a sudden break in postural control, the myoclonus being a compensatory reaction to sudden loss of postural control. This is purely speculative but is worthy of consideration in attempting to interpret myoclonus in association with cerebellar disease.

SOME RECENT EXPERIMENTS ON THE NATURE OF THE NERVE IMPULSE. Dr. E. Newton Harvey, Princeton University (by invitation).

Although it is quite certain that nothing flows along a nerve, something is transmitted—the nerve impulse. Galvani (1786) and du Bois Reymond (1843) identified the impulse with electricity, but Helmholtz' (1852) measurement of the velocity indicated a process too slow to be compared with the flow of electricity in a wire.

Is the process physical (comparable to a wave motion like sound) or chemical (comparable to an explosion trail in gunpowder)? In general, physical processes are little affected by temperature; chemical processes increase two or three times for a 10 degree rise in temperature. Wave motions suffer diminution as they progress; explosion trails are self-propagative processes.

Experiments indicate that within normal limits the rate of the nerve impulse is greatly affected by a rise in temperature. This can be most easily studied in a jellyfish, Cassiopea, made of a disk of tissue covered with muscle and a nerve network. Rings of tissue like a doughnut can be cut from the disk and a nerve impulse started in one direction which passes round and round the disk with a velocity of about 0.5 millimeter a second. The impulse is entrapped and can be seen moving around because the muscles are stimulated to contract with each revolution. For the 18 to 28 degrees of temperature interval, the temperature coefficient 0_{10}, is 2.4.

Such rings inform us whether the impulse is self-propagative and will move forever. I have kept a nerve impulse moving in such a ring for eleven days continuously with no change in rate. The impulse traveled 537 miles. It stopped after eleven days only because regenerating tissue gave rise to impulses which counteracted the entrapped impulses.

The evidence indicates that the nerve impulse is at base a chemical process, although no chemical changes can be directly demonstrated. The action current shows that electrical changes are important, so that we may regard the impulse as electrochemical in nature.

Lillie (1918) has pointed out a perfect analogy in the transmission of a wave of activation in passive iron. Passive iron is iron so treated that it fails to dissolve in dilute nitric acid. It behaves like a noble metal. If touched with ordinary or active iron, it becomes active also, and the activity is transmitted from the point touched as a wave which can be followed by the eye. The following characteristics are common to both nerve transmission and propagation of activity in passive metal wires: 1. The wave is a propagation of negativity or negative potential, and the negativity at one region activates ("stimulates") the conductor at the next region. 2. All kinds of stimuli (mechanical, chemical, electrical) will activate. 3. Activation by the electric current is a polar phenomenon occurring at the cathode (Pflueger's law). 4. Activation by the electric current is more effective as the current is suddenly increased in intensity (du Bois Reymond's law). 5. The phenomenon of electrotonus appears in passive iron as in nerve. 6. After activation, a refractory period exists when another impulse will not be transmitted. 7. Inhibition phenomena appear in passive iron as in nerves. 8. Unidirectional passage of a synapse is observed with passive iron and nickel. The wave of activation is easily transmitted from passive Ni (sensory) to passive Fe (motor) but not transmitted from Fe (motor) to Ni (sensory).

DISCUSSION

Dr. D. J. Edwards, Cornell Medical School (by invitation): It has been interesting to listen to Dr. Harvey's direct presentation of the puzzling problem of neurophysiology. It has been customary for physiologists to lay out in a painstaking way the elements of conduction and the conditions that modify conduction, but they have always passed quickly over the matter of the propagated disturbance in the nerve. Dr. Harvey has attempted to solve that problem. One feature of the discussion has been the application to a fundamental physiologic problem of research in a field which appears at first to be entirely unrelated. Attempts at elucidation of the problem show how difficult it is to predict the ultimate application of fundamental research. Another feature of this discussion has been the relatively rapid development of this subject in recent years. About seventy years ago Johannes Mueller asserted that we should never be able to measure the passage of the nervous impulse. Five years later Helmholtz demonstrated it by a method so simple that every first year medical student may prove it. Some years later Fillié called attention to the minimal oxygen content necessary for propagation of the nervous impulse, and Waller called attention to the carbon dioxid output of the nerve when it is undergoing conduction. These observations laid a background for the chemical conception of the nervous process. A few years later Keith Lucas began his researches and laid the foundation for the present work, by showing that the propagation is without decrement, that is, the process goes on without being reduced; this has led to the chemical conception of the nervous process which Dr. Harvey has emphasized and brought out. The importance of the bearing of certain physical analogies on the nature of the process has been applied with great exactitude in the result of Dr. Harvey's researches.

Dr. Joshua Rosett: I am gratified to find that the latest work in physiology has resulted in a conception of the nature of the nerve impulse that is very much like the conception formed by Herbert Spencer and which always appealed to me as sound. Spencer discussed the subject over forty years ago, and his line of reasoning is almost the same as that followed by Dr. Harvey in his presentation. Spencer, too, rejects the hypothesis of an electrical nature of the nerve impulse as untenable, mainly on the grounds of the nondissipation of the nerve impulse as it travels along the fiber and because of the vast difference in the respective rates of propagation of the two impulses. The excellent illustration employed by the speaker of a wave of isomeric change in a passive iron wire, brought about by a small disturbance, is paralleled by an illustration employed by Spencer in connection with the same subject. Spencer speaks of the transformation from black amorphous to white crystalline antimony in a wire of that metal occurring when a slight disturbance—a light tap, the application of a hot object, etc.—is communicated to the wire at any point.

Dr. Harvey (closing): Herbert Spencer's idea is a very similar one, and it differs apparently only in this—in the case of antimony the whole wire changes from one allotropic form to another, but in the passive iron phenomenon the iron becomes coated with some sort of oxid film which makes it take a different potential to ordinary iron when the two are connected. If we believe that white antimony has a different potential to black antimony, we shall have an electrical change and therefore a similar analogy.

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F. H. Packard, M.D., *President, in the Chair*

AN EXPERIMENTAL STUDY OF THE MECHANISM OF HALLUCINATIONS. Morton Prince, M.D.

Dr. Prince presented the results of an experimental research in the mechanism of hallucinations. All the traditional theories, he said, which could be classified in two groups—anatomicophysiologic and the psychologic—were unsatisfactory. As the result of previous study Dr. Prince had reached the conclusion that visual hallucinations were the emergence into consciousness of normal imagery pertaining to subconscious processes. The method of investigation previously employed by him was that of introspection in hypnosis, by which memories of subconscious processes were obtained. It remained to prove this theory by objective methods.

Such a research required a subject who exhibited both visual hallucinations and synchronously occurring subconscious processes which could be "tapped" by methods permitting physical records of the same to be obtained, namely, so-called automatic, that is subconscious, writing. Such a script, of which the subject would not consciously be aware during its production, would obviously be a physical record of ideas occurring subconsciously, and if an hallucination occurred synchronously its imagery might be correlated with the ideas of the script if the theory was valid.

The technic of the experiments was as follows: The head of the subject was covered with an opaque cloth to prevent her seeing the script as it was being written automatically by her hand. A pencil was then put into her hand which rested conveniently on a sheet of paper placed on a writing tablet by her side. She was then told to write automatically regarding some subject which was designated in general terms in each experiment: for instance, a memory of some remembered episode in her life; a memory of such an episode, but one forgotten by the subject; a fantasy; a fabrication requiring constructive imagination. The object of diversifying the subjects was to obtain products of different kinds of subconscious work (memory, dream-like fantasy, imaginations, etc.). If, during the experiment while the hand was writing an hallucination developed, the subject was directed to indicate the fact the moment she saw it by exclaiming, "picture." Thereupon a mark was made on the script at the point where the picture appeared. Likewise the moment the hallucination disappeared the subject exclaimed as directed, "gone," and the point was similarly marked on the script. Thus those words of the script which were written during the occurrence of any given hallucination could be identified and could be compared with the latter and any correlation of the written ideas and the hallucinatory images noted.

Under these conditions it was found that the writing of the script by a subconscious process was accompanied by a synchronously occurring hallucination.

After the observation was complete the script and the hallucination as recorded were compared and for this purpose arranged in parallel columns. Thus any correlations between the imagery of an hallucination and the synchronously written script could easily be noted. (The paralleled results, script and hallucination, were exhibited on the screen by lantern slides.)

On comparing in this way the description of the hallucination with the script it was easy to recognize that the images of the hallucination corresponded with the ideas recorded in the script and were such as normally would be the imagery contained in those ideas. For example: The script described a memory of a particular scene in a room at "Harvard University," and the imagery of the visual hallucination was an exact reproduction. The script was a verse describing in allegory a treasure chest, a fountain, golden musical instruments, etc., and the synchronously occurring hallucination was a perfect visual representation of those ideas, such as normally would be the case. The script described a fabricated romance and the personages of the romance and the local scenes were faithfully represented by the visual imagery of the hallucination; and so on.

After the observations were made the subconscious process was directed to answer in writing a questionnaire directed to ascertain what kind of process occurred subconsciously during the hallucinations and the relation of the one to the other. The script testified that during the production of the script images corresponding to the written ideas appeared first subconsciously, without the subject being consciously aware of them, and that then those images emerged into awareness as the hallucination.

A second series of experiments was made, the converse of the preceding; that is to say, hallucinations were primarily produced by fixation of the attention and the automatic script employed to determine what kind of subconscious process, if any, and its content, occurred synchronously. The results were the same as in the preceding series.

Auditory hallucinations were found to have the same mechanism, as was also the case with the imagery of a dream.

The following conclusions were drawn:

1. There is a type of visual hallucination in which the imagery has its source in a dissociated mental process of which the subject is not consciously aware. Such a process is by definition a subconscious one.

2. The content of this subconscious process contains images identical with the normal imagery of conscious thought.

3. The hallucination is due to the emergence into consciousness of the previously subconscious images. This emergence necessarily results in a hallucination in that the imagery of the latter is not related to the content of the conscious train of thought, but is foreign to the latter. This is a necessary consequence of the imagery being normal elements in a separate dissociated train (mental process).

4. The subconscious process is essentially a conscious one of thought.

5. There is a type of auditory hallucination which has essentially the same mechanism.

6. As there is a type of hallucination (visual and auditory) occurring in the insanities which is identical in form, structure and behavior with that produced experimentally in this study, the conclusion is justified that such hallucinations of the insane are due to the same mechanism.

7. The implication follows that when hallucinations of this type occur in the pathologic psychoses, they are indications of the activity of a dissociated subconscious process as a factor in the psychosis.

8. The hallucinatory phenomenon carries the further implication that the genesis and psychopathology of the psychosis are to be found in the forces which have determined the dissociation and motivated the subconscious process.

9. It is not to be assumed that all hallucinations have the mechanism of the type here studied. It is possible that in those occurring in the intoxication psychoses and in certain forms of organic brain disease, particularly when the hallucination is of a simple unelaborated static structure, the imagery is induced by direct irritation of the cortical or subcortical neurons. It is difficult, however, to exclude the possibility that the intoxicating agent or organic process simply removes inhibition and permits subconscious dissociated processes to function. Nor can we find any analogy with the known effect of irritation of motor and other areas of the brain. Irritation, as observed, produces simple movements and simple sensory phenomena (noises). Still, the possibility of irritating factors becoming the immediate excitants of organized complexes of neurons underlying the hallucinations, cannot be excluded. This theory, however, needs to be proved. Even the irritative theory, as opposed to the psychogenetic theory, permits the interpretation that the irritation excites a dissociated subconscious process from which images emerge into consciousness.

10. The psychologic problem of differentiating between normal imagery and hallucination disappears in that they are identical, the hallucination being only the normal imagery of a dissociated subconscious process.

11. If the evidence given by subconscious introspection be not accepted, a possible interpretation of the hallucinatory imagery is that the images do not themselves occur primarily as subconscious elements, but by the same mechanism appear in awareness as the conscious correlates of a coactive dissociated physiologic process; in other words, a subconscious process is neural, not psychic. On the other hand, such an interpretation does not take into account a large mass of collateral evidence for the psychical nature of processes occurring outside the field of awareness.

12. So far from a hallucination being a regression to an infantile form of thought (Freud), it is an element in highly developed adult thought processes.

13. The mechanism of the imagery of some dreams is the same as that of the hallucinations of the type here studied.

DISCUSSION

DR. DONALD GREGG: How can you determine that what is being written is unknown to the person?

DR. PRINCE: In one sense you cannot, any more than you can tell when a person comes into your office and says that he has a pain in his back that he is telling the truth and is not a malingerer. We must bear in mind that automatic writing, like lumbago, is a common phenomenon and has been observed and recorded by a large number of experimenters in all countries. It is, therefore, a well established phenomenon. It is always possible that a person may be a malingerer and the question, if raised, must be determined as in the malingering of other conditions. Let no one imagine, however, that medical men and scientists generally have a monopoly of integrity. The particular subject who was used in these experiments had written a large amount of material long before she came under my observation . She wrote automatically for her own pleasure. A number of investigators have trained themselves to write subconsciously and their testimony is unimpeachable. It is not difficult for some people to acquire this ability. In an audience like this, no doubt we could find two or three automatic writers, given proper conditions; then after say a month's practice and training we should probably find that a fair percentage of those present could produce automatic script.

Dr. Donald Gregg: In this particular case, did the subject know what she was writing?

Dr. Prince: No. Automatic writers differ very much in this respect. Some have no awareness at all of what the hand is writing and indeed may not know that the hand is moving at all, for in some cases the hand becomes temporarily anesthetic during the production of the script, as was first shown by William James. In other cases the written ideas of the script emerge into consciousness during the writing and yet it is automatically or subconsciously produced, as is shown by the fact that if the writing is stopped at any given moment the writer is found to be ignorant of what is going to be written and cannot consciously finish the sentence and the theme.

Whether or not the subject is aware at the moment of what the hand is writing is not in principle of importance for the script is still produced automatically. It may be of importance only for the particular experiment that is being made. Then, again, writing may be obtained from a person who had previously had complete anesthesia of the hand. The subject therefore cannot tell through the muscular action what the hand has written or know that the hand has moved at all.

An important phenomenon, frequently observed during subconscious writing when the subject is unaware of the written ideas, is the emergence, not of the ideas, but of the affect pertaining to the subconscious process. The affect of exaltation or joy, or depression or fear, may thus emerge into consciousness when such an affect does not belong to the conscious thoughts of the writer but can be traced to the subconscious process. This phenomenon I have observed hundreds of times under experimental and other conditions. I believe this to be the mechanism of the emotional state in many of the psychoses, such as manic-depressive states, some phobias, and even in many normal conditions. The affective condition is due, as I have said, to emergence into consciousness of the affect belonging to a dissociated subconscious process.

Question by a Member: Can a subject perform another action at the same time that he is writing?

Dr. Prince: In general, yes. But the performance of the action differs somewhat with its nature.. He can perform all ordinary movements, subject of course to the necessity of writing at the same time. He can observe accurately everything going on about him, such as watch and recognize accurately and without confusion what is passing in the streets, comment on and enjoy the situation, read aloud from a book, and so on. In the last instance, however, he is liable to go into a dreamy state, in which he keeps on reading. The trouble here is, I think, that it is difficult, even if possible, for two different processes to make use of the language function at one and the same time. There is apt to be blocking of one by the other. On the other hand, according to my experience, an automatic writer can passively observe, think freely and reflect on what he observes while the automatic writing is being produced. During the writing by such subjects as I have observed, it was difficult for the subject to find the precise language in which to express his conscious thoughts. In other words, he seemed to be largely robbed of the language function by the subconscious writing process.

Dr. D. A. Thom: Were the emotions of the subject appropriate to the hallucination she was going through?

Dr. Prince: Yes: In this connection, as an example of the emergence of the mood belonging to the subconscious processes, I may cite one observation in this study which is of interest.

When the subconscious system wrote as a joke a pretended spirit message and while this system, under interrogation in regard to it, manifested through the script, a humorous, almost hilarious mood, the subject herself without obvious reason was consciously in high spirits, joyful, and felt the spirit of fun. Later, during the latter part of the examination, when the subconscious system wrote bitterly and remorsefully of the past, confessing subconscious sins, the subject remarked during the production of this script, without knowing what the hand had written, "I feel serious now. All my high spirits and feeling of fun have left me. I have a sad, remorseful feeling."

I am astonished that psychiatrists have not made use of induced hallucinations in order to study the mechanism of hallucinations in the insane. Here is material and the method right at hand for experimental studies. The observations can be controlled and the hallucinations traced to their origin, and we have at least an approach for an attack of this and many other psychiatric problems. Likewise automatic writing is a most valuable means of research.

Question by a Member: Is it as easy to get automatic writing from the insane as from normal people?

Dr. Prince: In reply to the question just put to me I would say, unquestionably no. It is necessary to have complete cooperation between the subject and the experimenter, and in most insane people that is impossible. Then, too, the dominating mental processes of the insane block the impulses of any subconscious processes that might be stimulated to write automatically. On the other hand, there are many borderline cases, like those of the early stages of dementia praecox, in which automatic writing might be easily obtained and the experiments of the kind I have mentioned carried out.

Dr. E. W. Taylor: How about febrile delirium? I remember with interest a study which you made some years ago of a postpneumonic delirium in which you were able to explain absolutely the character of the hallucinatory phenomena that resulted.

Dr. Prince: Yes. It was a case in which during the delirium there were in activity normal conscious processes which perfectly oriented the situation, recognized clearly the delirious character of the conscious process and fully explained the delirium, and hallucination. I have observed this phenomenon several times. In this connection I may mention an experiment which I made comparatively recently in the case of delirium during typhoid fever and continuing during convalescence. I was asked to relieve the insomnia present by hypnotic suggestion. As I had a suspicion as to what might be the psychogenetic cause of the delirium I took the occasion to make the experiment, although I had little expectation of success at the time. While the patient was in hypnosis I made various explanations and suggestions along the line of the theory which I had formed as to the real cause of the delirium. The patient was living at that time in the country. I left him fast asleep and returned to Boston. I had hardly reached my house before the telephone rang and to my surprise the patient was at the other end and reported, to his great delight, that he had entirely recovered, that he recognized the delirious character of his ideas and that he was all right again. His delirium disappeared for good, and to my surprise my experiment was a success. My explanation is that the delirium at the time of the experiment was entirely functional. Whether this was its nature during the fever it is, of course, impossible to say, but if not it must have become transformed into a functional delirium. In the case of pneumonia, to which Dr. Taylor referred, I think it must have been a functional delirium from the beginning.

Dr. E. W. Taylor: Do you believe that such a method could be used generally?

Dr. Prince: I think not, for the same reason that the method is not practical in most cases of insanity. Perhaps, however, it might be used more than we think.

Dr. F. H. Packard: I take it that you meant the toxic condition had disappeared when the experiment was made, that there would be more chance of success under those circumstances than during the toxic period.

Dr. Prince: Precisely, if the primary delirium is really due to the effect of the toxemia. But I think that this pathology may be fairly questioned. To my way of thinking it is more probable that such delirium is due to the loss of inhibitions. The toxemia paralyzes the normal inhibitions thus permitting the abnormal processes constituting the delirium to take place, somewhat after the fashion of dreams.

Dr. E. W. Taylor: In the hallucinations of smell which we occasionally see in tumor of the temperosphenoidal lobe, there certainly appears to be a structural origin.

Dr. Prince: I think a simple sensory phenomenon might be obtained from a structural origin, such as a smell, a flash of light, or a noise like buzzing or whizzing, but not a complicated process like a visual picture or the musical strains of grand opera: that is to say, elaborate ideas with meaning.

Dr. E. W. Taylor: The original stimulus is certainly organic, whatever the elaboration of it may be.

Dr. Prince: As I have said, you may and do, undoubtedly, get simple sensory and motor phenomena from the pure stimulation of an organic process, but do you ever get elaborate hallucinations? I doubt it. Nor have I been able to find in the literature any accounts of such cases. Organic irritation of a motor center will produce simple movements like the flexion or extension of a limb: but did you ever hear of an organic irritation or a motor area exciting the complicated movements of a baseball pitcher—spitting on the ball, rubbing his hands in the mud, winding himself up and then delivering a curved ball to a "Babe Ruth"? That is practically what we are asking an organic process to do in producing analogous sensory and ideational phenomena by this theory.

Dr. Hugo Mella: What is the theory of the mechanism of the suppression of these inhibitions in cases of the nontoxic variety?

Dr. Prince: In such cases we have conflict, repression and consequent dissociation followed by the motivation of the dissociated system as a subconscious process by some strong anxiety, wish, aspiration or other impulse. The original breakup in this patient, for example, was due to a conflict between two sides of her nature, one longing for another, an intellectual life, believing that she had musical and other talents and hating the banal life she was obliged to follow; the other side motivated by the ordinary sense of duty and obligation and certain urges. It would take us too far away to go into these.

In reply to the question by a member whether I "asked the subject a question which was really directed to the subconscious and answered by the hand," I would say that this inquiry raises a complicated problem. As ordinarily expressed, I asked the hand, or the subconscious, a question. This, of course, while the subject was not hypnotized. That seems a paradox. It is, of course, a figure of speech. And, after all, it is a figure of speech to speak of the subconscious as a separate mind. We are really dealing with different mental systems or complexes of which the mind is constructed and which are more or less closely integrated into one mind. They are all one mind, and there is only one mind, however much the different systems of which it is composed may be temporarily disintegrated. In the latter condition the systems are out of gear, out of harmonious integration and cooperation. And yet by simply talking to a person you can reach the dissociated systems. It is not necessary to hypnotize the subject and bring these systems into the content of conscious awareness. Let us speak in terms of stimulus and reaction. A given stimulus strikes and awakens a reaction from a system which is so organized and attuned to it that it will react. Otherwise no reaction will follow. Thus, for example, if the composite content of conscious interest is solely occupied with thoughts and affects of a baseball game, a stimulus suggestion related to religion and going to church will awaken no reaction from the baseball content of conscious awareness, but it will, or may, strike and awaken a reaction from a subconscious system of religious memories, ideas and emotions, even though it be dissociated and though the memories be consciously forgotten. In practical therapeutics this principle is of the greatest value. However it be explained, the fact remains that questions and suggestions can stimulate and awaken a reaction from a dissociated system even though they have no meaning for the content of conscious awareness of the moment. The personality can be compared, in a way, to a complex manufacturing establishment, like the Ford plant. There is the casting department, the department where cylinders, gearing, bolts, nuts, wheels, bodies, etc., are made, and the assembling department. All are under a central executive control. Accordingly they all work harmoniously. But sometimes a strike occurs in one of the departments; the cylinder department refuses to cooperate and make cylinders. Not only efficiency is impaired, but economic adjustment of production of the integral parts to the total output is disarranged. The executive must get in touch with the group of strikers. He can do so without disturbing the other departments. Any questions, directions, or appeals to the strikers will not awaken a response from the departments that are at work. In the same way we can have a strike in any of the different systems of the mind and it can be settled in the same way, by arbitration, conciliation, persuasion or suggestion.

Of course our knowledge of the integration of the systems of the mind is superficial, and any explanation is incomplete. We can hold, however, to the empirical facts of experience.

As to psychotherapeutics: It is an art, not a science, though it makes use of scientific principles. This is one of the difficulties in teaching it. You can teach principles but their application is an art that comes from experience, like painting a picture.

As to the principles, what I am now going to say may sound arrogant, but I am going to say it: To investigators who have had long training in psychologic phenomena and particularly subconscious phenomena, and are familiar with them from personal observation and experimentation, as a bacteriologist is trained in bacteriology and a physicist in physics, the Freudians for the most part seem like amateurs, because very few, if any, show by their writings that they are familiar by personal training and experience with all the phenomena of the subconscious. What would you think of a person who undertook to formulate laws regarding the electrons, atoms and electricity and determine the ultimate nature of matter, who had only read the writings of physicists and whose own experiences were limited to the phenomena obtained from an amateur's wireless outfit, or to studying the discharge from a particle of radium or a roentgen-ray machine? Even Freud, himself, has never shown by his writings that he possessed the requisite training and experience, though he may not have disclosed it. Indeed he has repudiated the use of methods of research which others have found essential. One must know all the phenomena of the mind and not only those obtained by a single method of research like that of "free association" if one is to reach sound conclusions regarding the laws of the mind.

CHICAGO NEUROLOGICAL SOCIETY

Regular Meeting, Feb. 16, 1922

C. F. Read, M.D., *President, in the Chair*

AN UNUSUAL CASE OF PARALYSIS AGITANS. Hugh T. Patrick.

A physician, 52 years of age, has suffered from unilateral paralysis agitans sine agitatione for approximately two years. Tremor occurs occasionally in the arm when the patient is tired, and is of intention type. The unusual feature is the unilateral involvement of the face. The lips on the unaffected side open more widely in talking (the exclamation point mouth of Charcot) and in smiling, and the right eye closes more than the left. Such affection of the face is not so uncommon as I at first thought, for I find records of four similar cases among the histories of patients seen in my office. In two of these the right and in two the left side was involved. I believe there is no real paralysis in these cases, but that the muscles are involved by the peculiar rigidity of the disease and consequently are less responsive.

In the first of the four patients referred to, seen in September, 1899, it was some time before I discovered paralysis agitans, and the method of discovery is of some interest. In testing the strength of the unimpaired hand and forearm I asked the patient to grasp my hand firmly and supinate and pronate his own hand against my resistance. When he did this, the other, supposedly paretic hand, assumed the position of, and began to shake with the tremor of, paralysis agitans. I have never seen this method described in the literature, but it sometimes brings out the tremor when nothing else will. This patient also distinctly had involvement of the face. In maintaining the forehead wrinkled the right (affected) side would tire; then it would let down and the forehead on that side became smoother. In showing the teeth the right side lagged a little, and when he wrinkled his nose to "make a snoot" a tremor started on the right side of the face.

SPECIMEN OF CYSTIC TUMOR OF THE LEFT FRONTAL LOBE.
Peter Bassoe.

Three years ago following an injury to the upper jaw, a man, 26 years of age, had a discharging sinus in the gum. In July, 1921, he began to complain of frontal headache; in September, he had to be confined to bed; and in October, he became semistuporous. A few days after admittance to the Presbyterian Hospital he was shown in a clinic; he claimed that he was at the stock show. Examination revealed bilateral choked disk, the swelling on the right being 2 diopters and on the left 3.5 diopters. A bilateral Babinski sign was present, but the reflexes were otherwise normal. There was no paralysis or sensory disturbance. A cyst in the upper jaw containing creamy pus was evacuated, following which the headache was less severe. Further relief was obtained after lumbar puncture, which yielded a clear fluid under increased pressure (25 mm. mercury). All tests of the fluid, including the Lànge test, were negative. Visual form fields were normal, but there was a contracted color field in the right lower quadrant. On January 3, the swelling in the right disk was 3 diopters; in the left, 4 diopters. On January 5, Dr. C. B. Davis punctured both lateral ventricles through the occipital bone. No fluid was obtained on the left, but fluid spurted out from the right side under increased pressure. The patient was stuporous most of the time both before and after this operation. Weakness of the lower facial muscles on the right side became distinct. A tentative diagnosis of tumor or abscess of the left frontal lobe was made, and an operation planned for February 2. Coma developed during the preceding night and respiration ceased just before the time set for the operation; after two hours of artificial respiration the heart also stopped.

The brain showed in the left frontal lobe a cyst, 6 cm. in diameter, not connected with the ventricle but having a smooth lining which resembled ependyma both macroscopically and microscopically. At the other end of the cyst there was a solid gray tumor, 3 cm. in diameter, which reached the anterior and mesial surface of the brain where the dura was adherent. The tumor was apparently an endothelioma.

DISCUSSION

Dr. Lewis J. Pollock: I wish to call attention to the fact that this specimen is somewhat similar to that I showed at the last meeting. If the ventricles were studied to determine whether the aqueduct of Sylvius is patent, the cyst might be entered, with consequent failure to recover the indigo-carmin by spinal puncture.

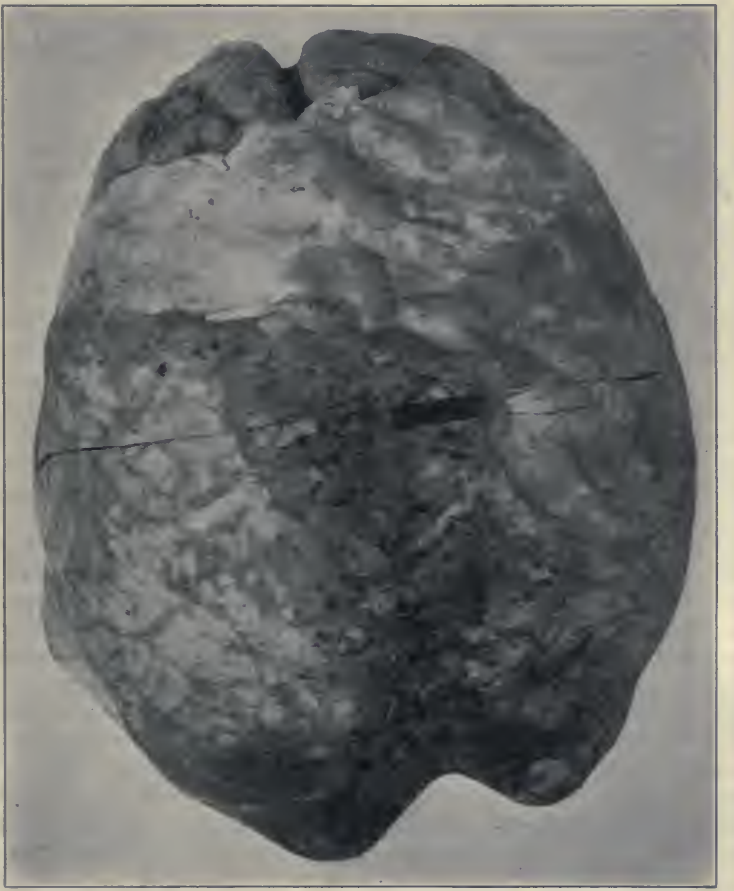
Dr. Hugh T. Patrick: Is there any explanation for the formation of a cyst in connection with an endothelioma?

Dr. D. B. Phemister: An endothelioma associated with a large cyst is certainly uncommon. All brain tumors with accompanying cysts that I had seen previous to this were gliomas.

TUMOR-LIKE INFILTRATION OF CEREBRAL DURA: A CASE OF LYMPHOSARCOMA WITH CLINICAL PICTURE OF HODGKIN'S DISEASE. Presented by Peter Bassoe.

This brain was taken from a man aged 35 years at death, who had developed glandular enlargement of the neck four years previously. He was under the care of Dr. Billings in the Presbyterian Hospital much of the time, and he died there. A careful record was kept and much laboratory work was done in the case, which was considered one of Hodgkin's disease. Cultures and vaccines were made and glands removed for histologic examination. At times the enlargement of both lymph glands and spleen seemed to have disappeared, but always to recur. All groups of glands were successively affected. When last admitted to the hospital, five weeks before death, mental dulness and failure of memory were noted. There was severe pain in the legs ascribed to local lymphoid infiltrations. Three weeks before death there were twitchings of the arms and legs and increased mental disturbance, but there were no convulsions or paralysis. A week before death an abscess developed in the left ear. Hiccup was frequent during the last two weeks, and vomiting during the last three days.

At necropsy, in addition to enlargement of spleen and lymph glands, there were erosion and lymphomatous infiltration of the sternum and of the skullcap. The dura was adherent, thickened, infiltrated with lymphoid tissue, and the site of numerous hemorrhagic spots having an appearance similar to that of chronic productive pachymeningitis. This "heterotopic" lymphoid infiltration, together with the general histologic features, indicates that the case should be considered one of lymphosarcoma rather than Hodgkin's disease.



Dural infiltration resembling chronic pachymeningitis in a case of generalized lymphosarcoma.

DISCUSSION

Dr. D. B. Phemister: I think the lesion in this case was a primary involvement of the skull with secondary invasion of the meninges. The marrow of several other bones also contained lymphosarcomatous tissue which had broken through the cortex. Against this view is the fact that the skull erosion was nearly all of the tabula interna. That would speak for primary meningeal involvement with secondary invasion of the bone.

AN ANALYSIS OF 146 CASES OF PARALYSIS AGITANS. Hugh T. Patrick and David M. Levy (by invitation).

This paper appears as an original article on page 711 of this issue.

DISCUSSION

Dr. Meyer Solomon: With respect to the correlation between the location of the injury and the site of the first symptoms, one wonders whether the injury was not the result rather than the cause of the disease, the patient having difficulty in using that part of the body.

Dr. W. G. Stearns: In the last six cases I have had under observation a Wassermann test of the spinal fluid gave from + to +++ reaction in three.

Dr. G. W. Hall: How did Dr. Levy arrive at the age? Is this the age at the time of consultation or of onset? Incidentally, it would seem that within a few years the age curve will have to be modified if the number of cases of so-called paralysis agitans following lethargic encephalitis is maintained.

Dr. Peter Bassoe: From now on it will be of interest to study the histories of infections these patients have suffered from prior to the onset because of the occurrence of paralysis agitans after epidemic encephalitis. While at first the tremor is different, as time goes on the resemblance to true paralysis agitans becomes greater. Some patients apparently recover, and then paralysis agitans in typical form develops long afterward. I have seen two cases this year in which the symptoms began one and two years after the acute illness. One patient, a woman, had epidemic encephalitis in 1919 and in 1921 developed typical parkinsonian tremor in one leg. She is only about 25 years of age, and I think it is fair to say that the preceding encephalitis must be considered the cause. Recently Marinesco has expressed the opinion that in such cases there is an actual infectious process which becomes chronic, and thus the parkinsonian syndrome is not merely a sequel but is an active and progressive disease. Marie and other French observers find that a history of trauma is less frequent than a history of some acute disease. That is the weakness in Dr. Levy's statistics. As he said, they were made from records of what was considered important at the time the history was taken, and I assume those records did not give an account of all previous infections.

Dr. A. B. Yudelson: The symptoms in the postencephalitic cases differ essentially from those in paralysis agitans in that the rigidity is not as great in proportion to the tremor. In six such cases seen during the past year all patients had marked generalized rhythmic tremor. Although this was of the parkinsonian type, it was more generalized and not of the typical "pill-rolling" character. A history of a profound infection of prolonged duration is usually easily elicited and is very characteristic.

Dr. David M. Levy, closing: The question concerning the site of the trauma can be quickly answered by going over a few of the case records. Age was taken at the time of onset and not at the time of examination. One man, aged 70, gave a history of falling and spraining the left arm. Two months later the disease started in that arm. A bricklayer, aged 48, fell from a building on his right shoulder. The right arm was limp and weak for six weeks; five years later the first symptoms of paralysis agitans appeared in the right hand. A man, aged 56, hurt his right wrist in a boxing match. Roentgen-ray examination showed a dislocation of the scaphoid bone. The right wrist was first involved in the disease. So in all cases, the traumatized side, where trauma had occurred, was involved first.

A history of syphilis was given in only three cases. Past illnesses were not recorded with a view to finding a possible cause for the disease but in the usual routine manner. The commonest form of previous infection noted was rheumatoid arthritis. Of eight cases in which the first part involved was noted, in six this part was first affected by the paralysis agitans.

I have here dealt only with classical paralysis agitans and have excluded the postencephalitic types. I have no statistics on such cases, but I have grouped the cases of epidemic encephalitis by decades and in comparison with the actual population. Parkinson's disease as a sequel to this infection would be liable to occur in any group, and the curve should follow an irregular line like that of encephalitis.

THE MAKEUP OF THE NEUROTIC. By Meyer Solomon.

All of us are in a state of unstable equilibrium. The neurotic is in a state of relatively greater instability than the average person and must struggle for poise and equilibrium more constantly, vigorously and persistently. The problem reduces itself to a study of the causes and manifestations of the disequilibrium.

The disequilibrium of the neurotic is shown by these traits: (1) Relatively increased nervous instability—oversensitiveness and undue irritability, typically illustrated by excessive disturbance from sudden noises or excessive stimulation. (2) Over-suggestibility, which may be general or special. The former is evidenced by excessive credulity and uncertainty resulting in mental conflicts, distractibility and confusion. Special suggestibility leads to marked habit formations, stubbornness and domination by ideas. (3) Lack of self control. (4) Nervous and mental excitability, as shown by impulsiveness, emotionalism on slight provocation, etc. (5) Fatigue which results in functional symptoms—visceral, skeletal, cerebral, emotional or moral. (6) Nervous and mental tension with uneasiness, restlessness and exaggerated knee jerks. (7) Awareness of these conditions with resultant self-consciousness, doubts and obsessions. (8) Difficulties of adjustment in regard to physical health, nervous or mental condition, moral-ethical-religious relations, social contacts, family problems, politico-economic problems and special wishes. (9) Pathologic fears and convictions.

The neurotic struggles for poise and equilibrium by flight or fight. He employs various means, often bizarre, and often goes to extremes. Efforts at flight may lead to hysteria, exaggerations, timidity and fears. Fight on the other hand may cause depreciation of others, hate, jealousy, self-expansiveness, over-altruistic notions and psychoses, particularly paranoid trends. Drug addiction, medical fads and nonmedical cults, devotion to religious and philosophic interests, peculiar habits; excessive craving for sensation, excitement and change may also be adopted.

The neurotic person is more apt to have excessive and prolonged mental conflicts, which are then the result and not the cause of the neurotic condition. But mental conflicts may of themselves produce nervous upset or aggravate the neurotic makeup, a vicious circle resulting.

Individualization is essential in the study and treatment of neurotic persons.

PHILADELPHIA NEUROLOGICAL SOCIETY

Feb. 24, 1922

Charles H. Frazier, M.D., *President*

HYPERTROPHICA MUSCULORUM VERA. Dr. Temple Fay.

A man, 60 years of age, a full blooded negro, from Dr. Spiller's service at the University Hospital, had always been well and strong prior to the fifteenth year, when he was ill for five weeks with what was diagnosed as pneumonia, although typhoid fever could not be ruled out. Two years later his entire left side suddenly became paralyzed; the skin on this side was hyperesthetic. He gradually recovered, and at 19 was able to use all the muscles and to do the most difficult type of labor.

The patient was 47 when first seen at the dispensary in 1909. At that time he complained of cramp-like pains in the muscles, accompanied by gradually increasing weakness. His neck muscles were so weak that his chin rested on the sternum, and he walked with a marked compensatory lordosis. After walking half a mile he would begin to stagger, and his leg muscles became weak. He was unable to lift heavy weights and had feeble power in the arms and shoulders, though these muscles appeared large and powerful. The trapezius, deltoid, biceps and triceps muscles were enormously developed and when contracted felt firm and hard. He had been doing hard laboring work for twenty years, but six years previously he first noted loss of strength. This gradually progressed until he became very weak in all his muscle groups, and was unable to work.

As muscular weakness appeared he suffered with severe pains and cramps, chiefly in the extremities. At this time his reflexes were prompt and equal. The Babinski sign, ankle clonus and Romberg sign were absent. The irides reacted normally to light and accommodation. He complained of difficulty in swallowing, and there was slight weakness of the bladder sphincter.

A specimen of muscle was removed in 1909 and carefully studied. The fibers were round in cross section and ranged from 80 to 180 microns, the average being 130 microns. The normal diameter of fibers from similar muscles is from 60 to 80 microns. There was no excess of fat or connective tissue found, and the muscles showed true hypertrophic changes.

The muscles, tested with the faradic current for two minutes, showed no reactions of myasthenia. An interesting test was carried out at Dr. Wood's request by Dr. McKenzie, who gave the patient the usual gymnasium tests. He did not reach the average of students who were of his muscular development, but fell far below the average of students who lead the most sedentary life.

Dr. Andrew H. Woods presented him before this Society in 1910, reporting the case in the *Journal of Nervous and Mental Disease,* Vol. 38, No. 9, 1911, myasthenia gravis, Thomsen's disease and pseudohypertrophic muscular dystrophy having been suggested as possible diagnoses. Electrical findings ruled out myasthenia gravis as there was no decrease in reactions of the muscles to strong faradism. He had no difficulty in starting voluntary movements and immediate relaxation of the muscles after a movement was completed, thus showing none of the typical signs of myotonia congenita. The microscopic findings of the muscle tissue were not those found in the pseudohypertrophic form of muscular dystrophy.

The patient still shows marked involvement of most of the muscle groups, especially those of the back, arms and legs, without atrophy. The anterior neck muscles are not hypertrophied. The Achilles reflex is absent on both sides, but the patellar reflexes are prompt. The plantar reflexes, station and sensation are normal.

The case is interesting because the progress of the disease in the last twelve years has not been marked. The calf muscles show slightly more enlargement at the present time than they did in 1909. For a period there was improvement, and he was able to take care of a garden; when, however, he was drawn into more active fields during the war, the weakness again returned and has become more progressive. The condition of the bladder and his difficulty in swallowing have not changed since his first appearance.

Dr. Spiller thought that the condition was one of trophic disturbance, causing a true hypertrophy of the muscle groups. In his paper before the International Medical Congress (*Brain* **34:** Part 1, 1913), he accepted the classification of Batten on the myopathies, but added to it the true hypertrophic type. He reported another case of this disorder at that time.

For a time, true muscular hypertrophy was thought to be due to venous thrombosis, for it was frequently observed following typhoid fever, and the enlargement usually came on quite rapidly. The generalized muscular hypertrophy in this case, as well as in the case of Léri, which showed extensive muscle group involvement following encephalitis, puts venous thrombosis out of the question.

It is remarkable that in so many of the cases reported by Krabbe (*Revue Neurologique,* No. 7-8, 1921) there was a previous history of typhoid fever, about a year before the hypertrophy developed. After careful study, he could find only twenty cases in the literature. Two patients suffered from paralytic conditions from which they recovered. In most of the cases, only one or two limbs were affected. There is only one other case cited by him in which all the extremities were involved. No cases were mentioned in which the hypertrophy was generalized throughout the trunk and back, as in the patient here presented.

Babinski compares the condition to hypertrophic ostitis. In regeneration, overgrowth of tissue is likely to occur, as in keloids, hypertrophic ostitis and amputation neuromas; and, physiologically, in the case of the heart and uterus. In true muscular hypertrophy, the regeneration following multiple neuritis leads to overgrowth of the muscle. This view has also been taken by Léri and Krabbe.

Weitz has reported two additional cases (*Deutsch. Ztschr. f. Nervenh.* **71:** No. 4-6, 1921) and his theory is that adult organs cease to grow because of the firmness of the structures, but that in disease there is a loss of the restraining tissue firmness that holds the muscle tissues to their normal size, and, with the weakening of this barrier, there develops hypertrophy of the fibers and consequent enlargement of the muscle.

However, with the present evidence at hand, it would seem that the condition has followed certain diseases that are capable of producing a severe neuritis, and the attendant muscle pains and cramps would bear this out. It is, therefore, possible that true muscular hypertrophy may be due to some form of trophic irritation which has persisted, following a multiple neuritis, possibly of toxic or infectious origin.

SPONTANEOUS BRAIN LESIONS OF MONKEYS. Dr. Baldwin Lucke.

In order to study the spontaneous lesions in the nervous system of the primates, the brains from twenty-two monkeys and apes which had died at the Philadelphia Zoological Garden were examined. It was found that nine monkeys had lesions similar to those found in human pathology. Of particular interest was the occurrence, in three animals, of a nonsuppurative meningo-encephalitis, resembling the lesions found in human epidemic (lethargic) encephalitis, acute poliomyelitis and certain other diseases. Cerebral arteriosclerosis occurred in four animals, in two of which marked calcification of the vessels and focal areas of necrosis and gliosis were present. In one animal, a solitary tubercle was found in the pons. In two animals, acute suppurative meningo-encephalitis was present. This was associated in one case with a pontile abscess. The conclusion may be reached that the interpretation of experimental lesions in monkeys requires great caution, since definite brain changes were found in more than 40 per cent. of the animals studied.

DISCUSSION

Dr. Williams B. Cadwalader: In considering the question of diseases of the nervous system in wild animals kept in captivity, one should never lose sight of the fact that these animals are existing under abnormal conditions. They are received after being transported from different parts of the world under most unfavorable conditions. The monkeys and apes on arrival are placed in quarantine, and are subjected to tuberculin tests. Only nontuberculous animals are exhibited. What effect tuberculin tests may have on the nervous system is not known. The diet of each animal is carefully regulated, but, in spite of this, gastro-enteritis is the most common cause of death; though monkeys and other apes are subject to respiratory diseases. The exact ages of the monkeys on arrival cannot be determined, but they are not usually adults. The chimpanzee in which Dr. Lucke found alterations of the blood vessels of the brain died of influenza, but, though carefully examined before death, had shown no cerebral symptoms. In a large series of specimens now in the laboratory of the Gardens, there are few brains that show any primary disease. This was reported by me to the Pathological Society in 1912, and at that meeting the statement was made that arteriosclerosis rarely occurred. It seems probable that the changes Dr. Lucke found have some relation to respiratory infections or toxemias from gastro-intestinal disease. Furthermore, the brains Dr. Lucke examined are old ones that have been preserved in formaldehyd solution for a long time. What effect this may have on the staining reactions of the tissues is uncertain. Speaking generally, it has been our experience at the Philadelphia Zoological Gardens that primary disease of the central nervous system in animals and birds rarely occurs.

Dr. C. M. Byrnes: It is remarkable that arterial sclerosis should be so pronounced in a monkey 11 months of age. What is the average duration of life for apes?

Dr. Baldwin Lucke: The duration of life of apes varies. It averages about five years, in captivity. This study illustrates the necessity for further investigations of spontaneous lesions in laboratory animals, for it is difficult to evaluate experimental lesions while our knowledge of spontaneous tissue changes is incomplete. All this applies, of course, particularly to animals in captivity, which are more likely to be used for laboratory studies than those in their natural state.

DISEASE OF THE OTOLITH APPARATUS, WITH REPORT OF A CASE. Dr. Robert J. Hunter.

My case shows a pathologic condition in which, I believe, the apparatus governing static equilibrium is involved, while that governing dynamic equilibrium remains intact.

Recently, Magnus and Kleijn rotated animals in a centrifuge at two thousand revolutions per minute, thus dislocating the otoliths in the otolith membranes. By examining the reflexes of the animals before and after rotation, and by examining the otolith organs histologically, they have come to the conclusion that it is the otolith organs exclusively that are concerned in sending out these tonic labyrinth reflexes to the body muscles, and in the maintenance of the position reflex and compensatory eye movements. They conclude that the otolith apparatus is not stimulated by centrifugal force or, in the case of rectilinear motion, by any lagging of the otoliths on progression; and they call attention to the fact that, in the case of the canals, the stimulus is on movement either starting or stopping, whereas, in the otolith membranes, the stimulus is constant from the time the head moves from the horizontal position. These investigators believe that, even in this position, there is a constant minimum stimulus for tonus. If this is the case, then disease of the otolith organs would cause signs induced by the position of the head rather than by rotation of the head.

Some interesting work on the dog-fish, in which the otoliths or the ampullae can be destroyed without injury to other parts, has been done by S. S. Maxwell. He concludes that most of the reflexes are activated by both semicircular canals and utricle, and finds the reflexes only destroyed when both organs are extirpated. He believes the saccule has nothing to do with equilibrium. This may be true of fishes, but not of the higher vertebrates. He also believes that the canals are not stimulated by the flow of endolymph, but by the pull of the utricle on the ampullae.

Bárány reported a case of disease of the otolith apparatus in the *Journal of Laryngology and Otology*, May, 1921. It is the only one I have been able to find.

My case differs from the one reported by Bárány, but is, I believe, due to injury of the otolith apparatus. C. C., a boy of 14 years was referred to me at the Lankenau Hospital. His history, with the exception of three falls, was negative. His mother noticed that he held his head sideways soon after he had the second fall. The patient presented as his most prominent physical sign a marked horizontal nystagmus with excursions varying greatly. His mother was of the opinion that the nystagmus grew worse when he became excited. The nystagmus was horizontal when the head was held with the horizontal semicircular canals parallel to the floor. In this position, with a pencil at the near point, the movement was so small and fine that it was difficult to describe its direction. On looking to the right, he had horizontal nystagmus to the right, which was quick and of small amplitude. On moving the eyes to the left, he had horizontal nystagmus to the left, the amplitude being greater but the frequency less. When he looked at a distant point, he had marked horizontal nystagmus which was very quick, of good amplitude, and with the quick component to the left; when he looked at an object close at hand, he had noted that the violent movement stopped. When he put his head to the left side at an angle of 15 degrees, the nystagmus stopped. On holding his head straight or looking at a distance, he grew dizzy and sick at the stomach. He defined dizziness as a state in which objects moved back and forth, the room not going around. When he looked up, the nystagmus continued to be horizontal and to the left; when he looked down, it was very slight. With the eyes closed, and the head at 30 degrees forward, both eyes appeared to be turned inward and slightly upward. When the eyes were opened after forcible closure, they looked straight ahead, then turned upward and outward. With his hand 60 degrees back, he held his eyes still for some seconds, when they again oscillated. With his head over either to the left or to the right shoulder, he could almost hold the eyes still. With his head 30 degrees forward, he had spontaneous past pointing, when tested in the perpendicular plane, of 2 inches (5 cm.) to the left with the right arm, and 3 inches (7.5 cm.) to the right with the left arm. With the head in the same position, the past pointing in the horizontal plane gave 2 inches (5 cm.) below with the right arm, and touches with the left arm. With the head 60 degrees backward he touched normally when moving the arms in the perpendicular plane. With his right leg (when the head was 30 degrees forward), he spontaneously past pointed to the right. With the left leg, he touched normally. When the head was 60 degrees backward, he touched with both feet. With the head held in the patient's favorite position, he past pointed normally with his arms moving in the perpendicular plane, also with his arms moving in a horizontal plane. With the right leg, he was a little uncertain in pointing, going sometimes to the right and sometimes to the left, but with the left leg he touched.

Both ear drums were retracted and there was an old scar in the posterior quadrant on the right side. The hearing was normal. The caloric and rotation tests were normal. The eye and neurologic reports were negative.

Since the nystagmus became more marked on changing the position of the head and as the usual Bárány tests showed that impulses went normally through all pathways and the results of the tests were normal, I feel that this was probably a case of disease of the otolith apparatus in distinction to disease of the semicircular canals. I base this opinion on the fact that the canals were normal and the position of the head seemed to aggravate his symptoms. The patient carried his head to one side and was comfortable in that position, but when he held it upright, nystagmus became very marked, he became nauseated and dizzy, and the tests revealed abnormal conditions.

Book Reviews

AN ESSAY ON THE PHYSIOLOGY OF MIND. An Interpretation Based on Biological, Morphological, Physical and Chemical Considerations. By FRANCIS X. DERCUM, A.M., M.D., PH.D., Professor of Nervous and Mental Diseases in the Jefferson Medical College. Cloth. Price, $1.75 net. Pp. 150. Philadelphia: W. B. Saunders Company, 1922.

The modern critical or scientific study of Mind was inaugurated by the school of psychologists which dates from Bacon and Descartes, and has its greatest names in Locke, Berkeley, Hume and Kant. Its method was truly scientific in that it broke away from the old scholastic speculation, and relied on a critical study of mental phenomena. Hence the reproach which is sometimes brought against it, that it was metaphysical, is unfounded; and can only be raised by those who are dissatisfied with the study of consciousness as equivalent with the study of mind. The method of Locke, Berkeley and Hume was by introspection; they ignored the anatomy and physiology of the brain, of which indeed they knew little, although Locke had studied medicine and was in full accord with its spirit and aims. The problems they set before them were the nature of knowledge, sensations, ideas and mental processes in general; and they believed that these problems could be successfully approached by looking inward at the activities of the mind by the only avenue possible, namely, by consciousness. That this method has its limitations, no one will deny; but this fact does not detract from its merits. Indeed, it is a method which must always continue in use; to abandon it is inconceivable. The modern science of psychiatry depends largely on it, and always will depend on it. We study the abnormal processes of the mind by the methods of psychologic introspection; and the Freudians even tell us that by this method they can probe beneath the surface and reveal the secrets of the subconscious. The study of brain cells and neuroglia, of dendrites, lymphocytes and infections, may supplement this method, but it is safe to say that it will never supplant it.

This psychologic school threw no light on the problem of substance in its relationship to mind; they were not interested in morphology, because, apparently, they believed that we cannot know the nature of matter; therefore, that we cannot hope to know how consciousness is a phenomenon of matter. If any of their critics have solved this problem, they have, up to the time of this writing, kept the secret to themselves.

It was inevitable, however, with the growth of the sciences of histology and pathology, that the attempt should be made to correlate their results with the well-established principles of psychology. As physicians we know only too well that infections and the diseases of brain cells have their psychologic reactions. We also know that heredity and environment are controlling factors in the evolution of character; in the manifold phenomena of behavior. The risk has been, however, that mere formalism, or materialism, such as is acquired by the too exclusive use of the microscope, would obstruct a broad view of problems which are vital to the physician as well as to the psychologist. Many of these problems will never be solved in the laboratory.

Dr. Dercum has sought to give a biologic interpretation of "mind," and his book is useful as presenting this aspect of the subject. He has evidently wanted to avoid metaphysics, and calls attention to the fact that the word "psyche" has not been used by him. In order to make a good start he begins properly with the lower forms of life, for it is evident that, from the biologic standpoint, the very beginning of psychic function is to be observed in these lower forms, as was maintained by Haeckel. The elementary biologic processes, such as in the selection and appropriation of food by the ameba, are doubtless biochemical or physicochemical in nature; yet they represent the earliest example of "choice," which has not yet risen to the level of a volitional act. It is a so-called "tropism"; and it is one of the earliest, if not the earliest, of the instincts. The physiology of the cell, as shown not only in the selection of food but also in the transmission of impulses and in motor reactions, as well as in a tendency to differentiation, or a division of function—all this physiology is discussed clearly by Dr. Dercum, and it is used by him as the basis of his thesis. If the reader keeps this in mind, the unfolding of the argument proceeds naturally and easily. The point of view is that of the biologist and evolutionist; and the great value of the book, and the satisfaction which arises from reading it, come from the fact that it is logical and well presented.

We cannot venture, in a brief review, to go into details. Dr. Dercum follows closely the evolutionary scheme, as it has been worked out through the ages, and presents step by step the unfolding of the cerebrospinal system. From the lower to higher levels, from spinal segments to the neopallium, from instincts to intelligence, the story of the neurons is told up to the supreme level of the mental faculties. When he reaches the stage of "consciousness" he is reticent, and perhaps wisely so, for no one has ever defined consciousness. We have to accept it as one of the ultimate facts. It defies definition. "Whatever it is," he says, "it is constantly changing." In this fact, perhaps, we see its elusive nature; but this does not absolve us from the necessity of studying it, as did the old psychologists, if we are ever to gain an adequate knowledge of the physiology of the mind.

Dr. Dercum, in discussing the physiology of the neuron, reverts to his theory of the retraction of the processes of the neuron as the cause of some of the symptoms of hysteria; the contacts of one cell with another are broken, hence occur the paralyses, anesthesias and various stigmas of the disease. This mechanistic theory is brought forward by the author very appropriately to illustrate the biologic conception of his book. The attempt to give a purely physiologic explanation of such higher mental faculties as will, initiative, thought, etc., is also made, but the subject is one of extraordinary difficulty, and it is perhaps too soon yet to attempt it. But the explanation of the physiology of the unconscious field, that is, that it is merely a reawakening of memories by the power of association, is a valid one, and it can readily be assimilated to the "laws of the association of ideas" which were established by the old psychologists. The psychanalyzers would do well sometimes to take heed of this. It remains for them to prove, on biologic grounds, that there are any active processes in the subconscious, such as they describe, or that it is anything other than a storehouse of memories.

It is very interesting to note that, although Dr. Dercum disclaims being a metaphysician, he takes a position on the subject of human knowledge that is closely akin to that of Bishop Berkeley; for he seems to hold (p. 119) that "we can only be conscious of the changes in the protoplasm of our own substance." In other words, we only know our own mental processes, and have no certain knowledge that these processes represent an external reality. This comes very near to Berkeleyan "idealism"; and shows in an interesting way that the great problems are the same after all, whether they are approached on the one side by the "psychologist," or on the other side by the "biologist."

HUMAN BEHAVIOR. In Relation to the Study of Educational, Social and Ethical Problems. By STEWART PATON, M.D. New York: Charles Scribner's Sons, 1921.

The preface to this book must serve as the preface to the review. "The importance of the subject is obvious and has been tragically emphasized by the present world crisis. Little is known about man as he is. Imagination has supplied many of the details in the picture of what he was once supposed to be, while disappointment associated with unrealized expectations of what he might have become has increased the difficulties of taking measures of his present stature. Parent, teacher, physician, student of social phenomena, prospective reformer, statesman, and philosopher, each has his special interest in the great human problem. Today every intelligent citizen is anxiously awaiting the solution to the problem of how 'democracy may be made safe for the world.' There can be little doubt that in the careful, painstaking study of man as he is will be found the means by which human institutions may be established upon a more rational basis and at least an intelligent effort made to lay the foundations of a durable peace."

Readers of the ARCHIVES will be interested in the neuropsychiatric aspects of any study of "human behavior." Neurologists will find most familiar ground in the account of special mechanisms of adjustment which makes Chapter 3 a very generalized account of the central nervous system. Psychiatrists will find Dr. Campbell's chart of the levels at which mental disease may arise at the beginning of Chapter 2 and later in the same chapter and in Chapter 11 specific references to the unconscious in mental disease. Dementia praecox is mentioned only once. And yet the methods proposed for the betterment of a poorly managed world are psychiatric, and the psychiatrist will find much encouragement in noting the suggestions which are made about the social value of by-products of his own proper job.

Early in the book we meet these stimulating statements, which are here loosely quoted. Human beings are governed more by their emotions and less by their intellects than they think they are. Physical characteristics have more to do with the development of character than is recognized. Moralists have forced us this way and that without considering whether the later state was worse than the first; performing operations which were sometimes "pronounced a success, in spite of the intellectual and moral death of the patient." Man has been too proud to study his own behavior as he studies that of lower forms; he has created "an imaginary world, inhabited only by people at the prime of their activities" and ruled by a conscious reason which sharply differentiated them from the animal (and the child and the insane). Note the standards of the people of "Main Street." "Systems of law, ethics, religion, and education were deliberately planned with reference only to the needs of the relatively few persons who were capable of attaining a high degree of intellectual activity and volitional control."

If these things are so, then the establishment of human life on a better basis depends on the acquisition of self-knowledge. The moralist must study behavior in animals and man without reference to causes and dispassionately. The biologic reactions of man "may be governed by laws no harder to understand than is the law of gravitation." We must study them in the dog, ape, child, and in the insane because there are found to be the simpler reactions.

Finely spun definitions, such as efforts to define the conscious, are not going to be of great value. Into the response which the total individual as a unit makes goes something that he knows about and something that he knows less about—called indifferently the unconscious, or habit, or organic memory or subconscious. There is a sliding partition between conscious and unconscious, and between voluntary and involuntary, and we can let it go at that.

The trouble with the central part of the book is that in its study of the organization of the personality, one misses the person. The synthesis which is promised is not there. The triad of autonomic nervous system, internal secretions, and the conditional reflex play a large part in explaining the development of the personality. The over or under function of any part disturbs the reactions tending to preserve the unity of the organism. So when "psychologic tension" is lowered it carries down with it the "quantity of action," the inventive power and the general "adaptive capacity," and we have a quiet depression. But if the psychologic force is not lowered in proportion to the lowering of the tension an agitated depression results. Many figures of speech occur which might lead the reader too far; why should the stream of energy, if dammed from its appropriate channels, displace the affect? We look at this and that piece of mechanism, but do not see its integration or its therapeutic helpfulness. We are thrown back for helpful suggestions on the value of instilling good habits, of protecting children from emotional shocks, of studying all the motor impulses of children, of grading occupation and environment to objectively determined mental states. If all men could be studied and managed as are the favored insane!

The book has a good big idea and many valuable suggestions.

THE PRACTICAL MEDICINE SERIES. Comprising Eight Volumes on the Year's Progress in Medicine and Surgery. Under the General Editorial Charge of CHARLES L. MIX, A.M., M.D., Professor of Physical Diagnosis in the Northwestern University Medical School. Volume VIII. Nervous and Mental Diseases. Edited by PETER BASSOE, M.D., Associate Professor of Nervous and Mental Diseases, Rush Medical College. Price, $1.75. Pp. 249. Chicago: The Year Book Publishers, 1921.

The present volume maintains the high standard of previous years and is as good a summary of the year's output of neuropsychiatric literature as could be arranged in a volume of this size. The entire field is covered, with special attention to some subjects. For instance, there are twenty-nine pages on the various phases of lethargic encephalitis and several pages on related conditions. Seventeen pages are devoted to neurosyphilis.

Among the interesting things discussed, we may mention brain changes in poisoning by illuminating gas, colloid and calcareous degeneration of cerebral vessels, the parkinsonian syndromes, an excellent report on myelomalacia, injection of air into the spinal canal for diagnostic purposes and nervous symptoms due to vertebral anomalies.

There are sixty pages of excellent matter on mental diseases. We believe nothing of importance has escaped the eye of the editor. The illustrations are good and the index adequate.

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